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AUTOMATIC TARGET CUER.(U)
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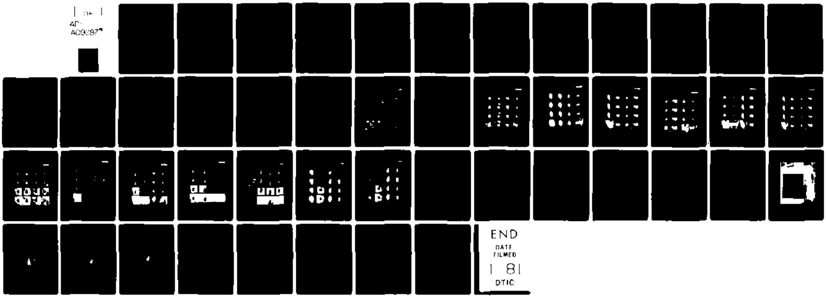

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AUTOMATIC TARGET CUER
THIRD QUARTER REPORT

Prepared by

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1 April 1980

QUARTERLY REPORT
FOR PERIOD
1 January 1980 — 1 April 1980

NIGHT VISION AND ELECTRO-OPTICS LABORATORY
FORT BELVOIR, VIRGINIA 22060

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NORT- 80Y033	2. GOVT ACCESSION NO. AD-A092 877	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AUTOMATIC TARGET CUER ~~THIRD QUARTER REPORT~~		5. TYPE OF REPORT & PERIOD COVERED QUARTERLY PROGRESS REPORT no. 3 1 JAN — 1 APR 1980
		6. PERFORMING ORG. REPORT NUMBER 80Y033
7. AUTHOR(s) B. Deal, C.M. Lo, R. Taylor, T. Daggett J. Powers, ~~K. Hale, G. Parker~~		8. CONTRACT OR GRANT NUMBER(s) DAAK70-79-C-0066
9. PERFORMING ORGANIZATION NAME AND ADDRESS Northrop Electro-Mechanical Division 500 East Orangethorpe Avenue Anaheim, California 92801		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 47
11. CONTROLLING OFFICE NAME AND ADDRESS Night Vision and Electro-Optics Laboratory Fort Belvoir, VA 22060		12. REPORT DATE 1 April 1980
		13. NUMBER OF PAGES 49
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Infrared	Target Recognition
FLIR	Image Enhancement
Target Cuer	Image Segmentation

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is the third quarterly progress report for the ATC program. It covers system organization and specific algorithm development, leading to the construction of a real-time target cueing system.

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SECTION 1
INTRODUCTION AND SUMMARY

This is the third quarterly progress report for the Automatic Target Cuer (ATC) Program, Contract No. DAAK70-79-C-0066. The ATC Program is a 30-month effort which will culminate in the delivery of two developmental ATC systems to the Night Vision and Electro-Optical Laboratory (NV&EOL). The first system will be in an engineering, breadboard-type configuration, while the second system will be an airworthy unit integrated with the Light Observation Helicopter Target Acquisition/Designation System (LOHTADS). Flight tests will be conducted with the second unit.

The LOHTADS operator currently would benefit from automated assistance for target acquisition and sensor operation. The goal of the ATC system is to aid in the performance of the operator's tasks by providing cues for targets at ranges at the limits of the electro-optical sensor acuity, and by performing automatic contrast enhancement and control for the displayed image.

The ATC program is divided into three phases. Phase I (6 months) is the system analysis and design effort that includes algorithm development and tradeoff studies. Also included in Phase I is the design and construction of the ATC interfaces and memories. Phase II (13 months) is a modeling and construction phase. The hardware and software specified and designed during Phase I will be constructed during this effort. The specific hardware functions of the ATC will also be modeled, in software, to facilitate system analysis and test. Phase II culminates with the completion of the Model 1 ATC system. During the third phase (11 months), which is primarily a construction and test phase, the Model 2 ATC system will be built. The construction of the Model 2 ATC will basically involve a repackaging of the Model 1 system in an airworthy configuration. Extensive tests will be conducted on both the Model 1 and Model 2 systems during Phase III.

The ATC program has presently completed the first three months of the modeling and construction phase. Much of the Model 1 hardware has been completed and is ready for initial integration with the LOHTADS system. The status of each aspect of the Model 1 development is summarized in Table 1-1.

Table 1-1. ATC Status Summary (Percent Complete)

	Design	Simulation	Construction	Stand-Alone Test	Integration
FLIR Interface					
Digitizer	100	N/A	100	100	0
Filters	100	N/A	100	20	0
Position Sensor	100	N/A	100	100	20
Model No. 1 ATC					
Controller	100	N/A	100	100	0
D/A	100	N/A	100	100	0
Frame Memory	100	N/A	100	40	0
Scan Converter	100	N/A	100	50	0
Enhancement	100	100	100	50	0
Detection					
Algorithm	60	10	N/A	N/A	N/A
Hardware	10	0	0	0	0
Silhouetting					
Software	90	90	0	0	
Hardware	20	10	0	0	0
Classification					
Software	70	20	0	0	0
Hardware	0	0	0	0	0
Instrumentation System					
Software	100		100	80	0
Hardware	100		100	90	0
Target Data Base	95		80	N/A	N/A

The FLIR digitizer (described in the top part of Table 1-1) is complete with the exception of the anti-aliasing filters which are undergoing initial tests. A two-stage, four-pole active filter has been implemented for each infrared (IR) detector channel to ensure accurate digitization of the IR image. The band pass and gain for each filter stage is presented in Section 4 of this report.

Hardware for the full frame rate path of the Model 1 ATC is also complete and is currently undergoing test.

The algorithm system for target silhouetting is defined in Section 3. The system builds on the improved silhouetting system presented last quarter. Logic has been added to examine output of the system to determine if the target is hot or cold and to separate small clutter objects from the primary target silhouette. Examples of the performance of the complete silhouetting system are also presented.

Last quarter, the University of Maryland target features were selected for use in the Model 1 ATC system. Section 2 of this report presents a detailed functional design for the target feature extraction software. The design shows the interrelationships of intermediated feature variables and will lead to a very time-efficient software implementation of the feature extraction task.

Section 5 of this report describes the current state of the FLIR image data base. During the reporting period, the image data base has been transferred from tape to a random access medium. The ground truth for each image has also been placed in a fixed format header attached to the image. Having ground truth available in this format will greatly facilitate the simulation tasks of the next quarter.

SECTION 2
TARGET FEATURE DESIGN

This section describes the design status of the feature extraction algorithms which were identified last quarter. The main objectives of this quarter's effort are: (1) define the algorithm structure to generate the target features, and (2) establish functional input-output interfaces. A top level detail of the interfaces of the feature extraction function is shown in Figure 2-1.

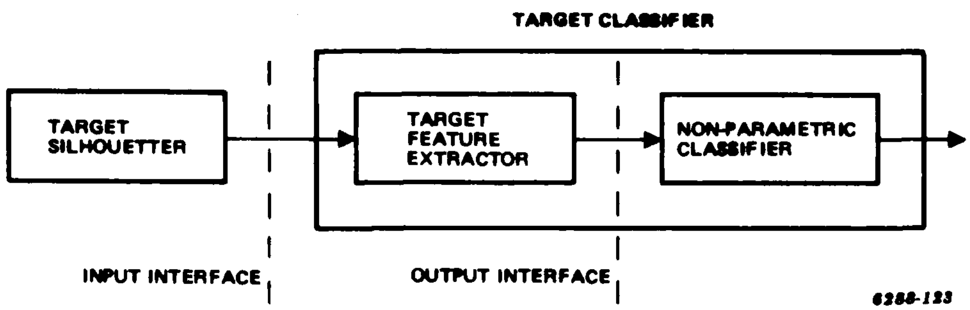


Figure 2-1. Target Feature Extractor, Input/Output Interfaces

2.1 COMPUTATIONAL FLOW

A computational structure chart shows sequences of computation involved in feature extraction.

The computational flow can be described by a "bubble" chart. A bubble represents transformation of data from one form to another. The direction of flow is determined by arrows. Figure 2-2 illustrates a bubble with input/output parameters and Figure 2-3 shows a specific example. Data, consisting of a target silhouette, is used as input for a computing function which determines the center of gravity of the silhouette. The lower bubble consists of a function that computes the corresponding target moment of inertia and outputs this data.

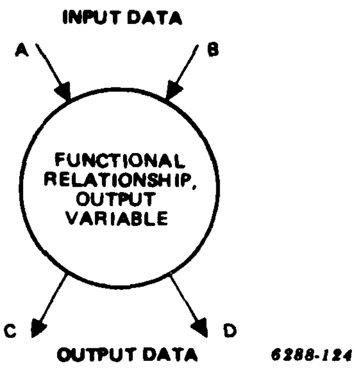


Figure 2-2. Elementary Bubble

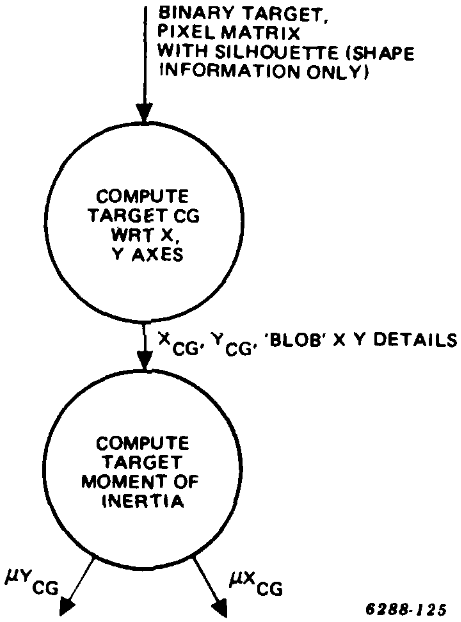


Figure 2-3. Example of Bubble

2.2 TARGET FEATURE EXTRACTOR MODULE (TFEM)

The complete detailed interfaces and computational flow bubbles for the Maryland target features are shown in Figure 2-4. Information that can be derived from this chart is listed below.

2.2.1 Input Interface

The silhouette function furnishes the following quantities to the TFEM:

a. Binary silhouette
b. Area in pels
c. Perimeter in pels
d. Sum of all target pel values
e. Sum of squares of all target pel values
f. Sum of target interior pel values
g. Sum of target perimeter pel values
h. Sum of target edge map values.

2.2.2 Output Interface

The TFEM furnishes target features #1 through #10 to the nonparametric classifier.

2.2.3 Number of Structured Layers and Operations

The bubbles in Figure 2-4 are laid out in horizontal layers. The output target features may be computed by one of two methods. In one approach, features are computed one at a time by starting at the top bubble for each feature and going through the appropriate bubbles in each layer until the output feature is obtained. A second approach performs all the computations on any given layer before proceeding to the next layer. The first approach has the advantage of independence of functional flow and ease of modification, whereas the second has the advantage of computing the output of each bubble only once.

The number of bubbles and operations in each layer is given in Table 2-1. The number of operations shown are for a 32- by 32-pel subframe.

During the next quarter, the detailed implementation of some of the more computationally expensive bubbles will be examined. An example of the level of detail and some of the alternatives to be considered are shown in Figure 2-5. The overall impact (speed, memory usage, etc.) of each of the alternatives will be determined and the optimum system will be implemented.

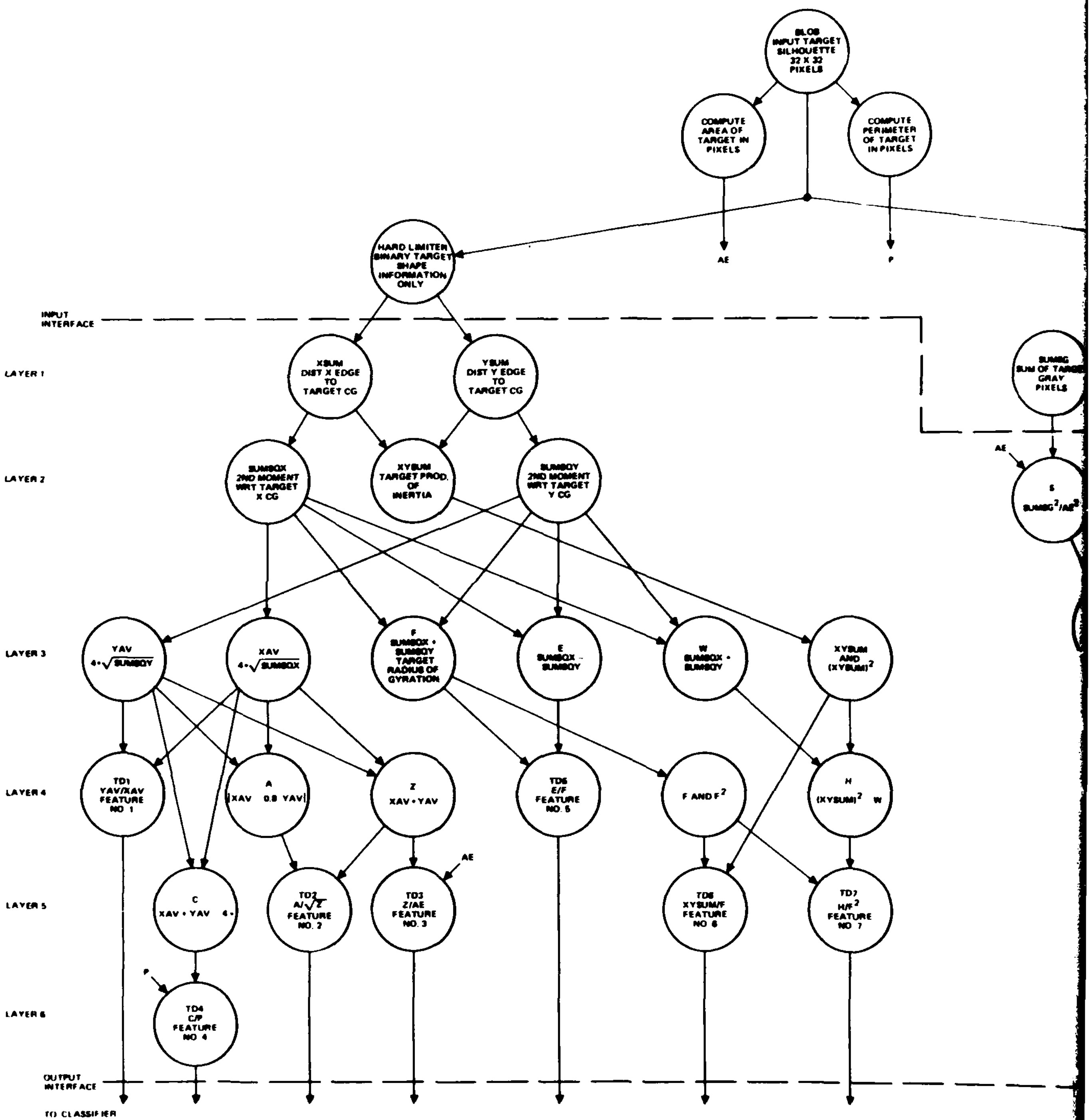
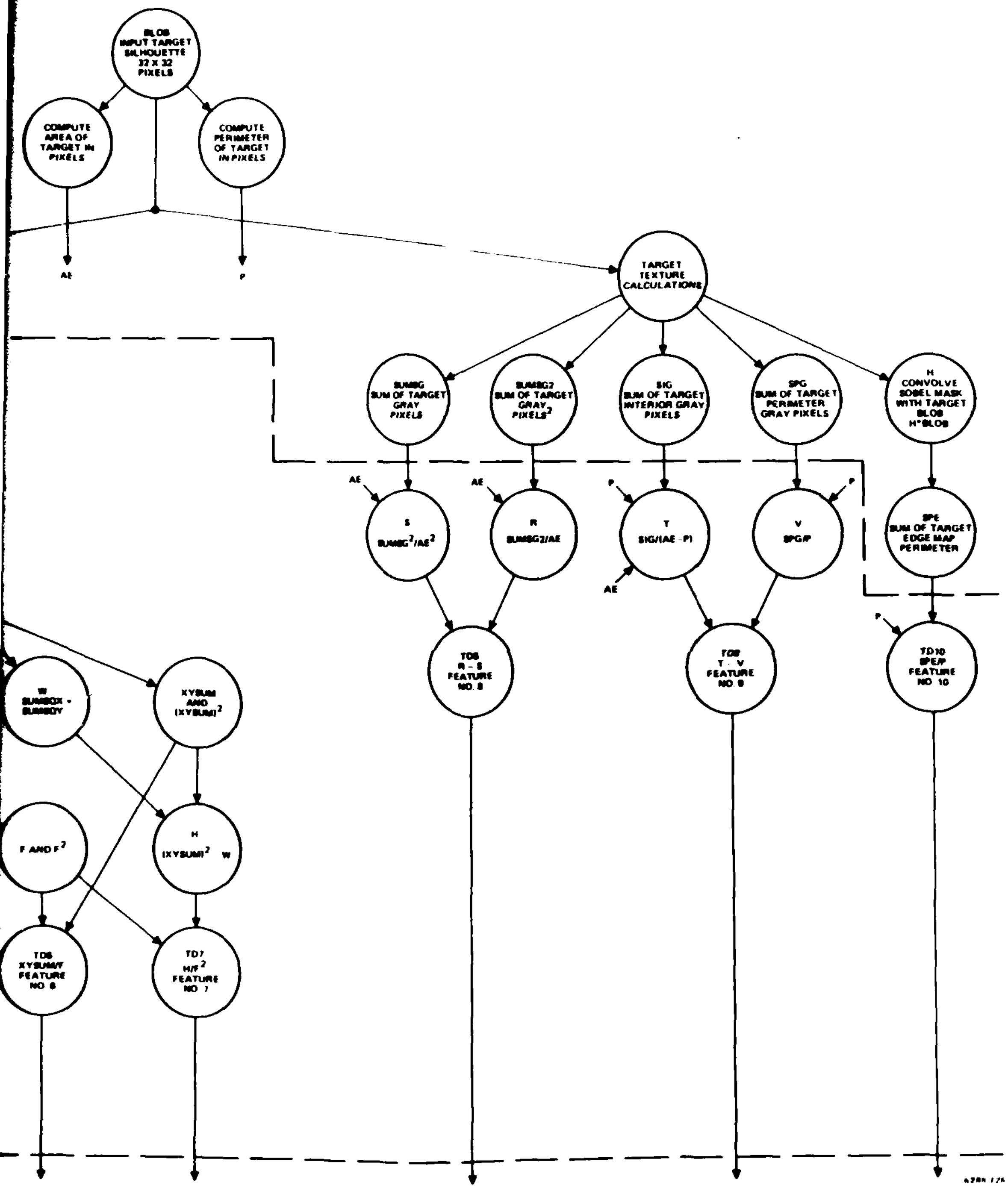


Figure 2-4. Feature Extraction Algorithm



BLOB
INPUT TARGET
SILHOUETTE
32 X 32
PIXELS
COMPUTE
AREA OF
TARGET IN
PIXELS
COMPUTE
PERIMETER
OF TARGET
IN PIXELS
AE
P
TARGET
TEXTURE
CALCULATIONS
SUMBG
SUM OF TARGET
GRAY
PIXELS
SUMBG2
SUM OF TARGET
GRAY
PIXELS²
SIG
SUM OF TARGET
INTERIOR GRAY
PIXELS
SPG
SUM OF TARGET
PERIMETER
GRAY PIXELS
H
CONVOLVE
SOBEL MASK
WITH TARGET
BLOB
H*BLOB
AE
S
SUMBG²/AE²
AE
R
SUMBG2/AE
P
T
SIG/(AE - P)
AE
V
SPG/P
P
SPE
SUM OF TARGET
EDGE MAP
PERIMETER
TD8
R - S
FEATURE
NO. 8
TD9
T V
FEATURE
NO. 9
P
TD10
SPE/P
FEATURE
NO 10
W
XYSUM
AND
(XYSUM)²
F AND F²
H
(XYSUM)² W
TD6
XYSUM/F
FEATURE
NO 6
TD7
H/F²
FEATURE
NO 7

2

Table 2-1. Complexity of Bubble Layers

	Number of Bubbles	Signed Adds	Multiplies	Square Roots
Layer #1	2	2048	2	0
Layer #2	7	3073	3076	0
Layer #3	9	4	5	2
Layer #4	6	2	6	0
Layer #5	5	2	5	1
Layer #6	1	0	1	0
Total	30	5129	3095	3

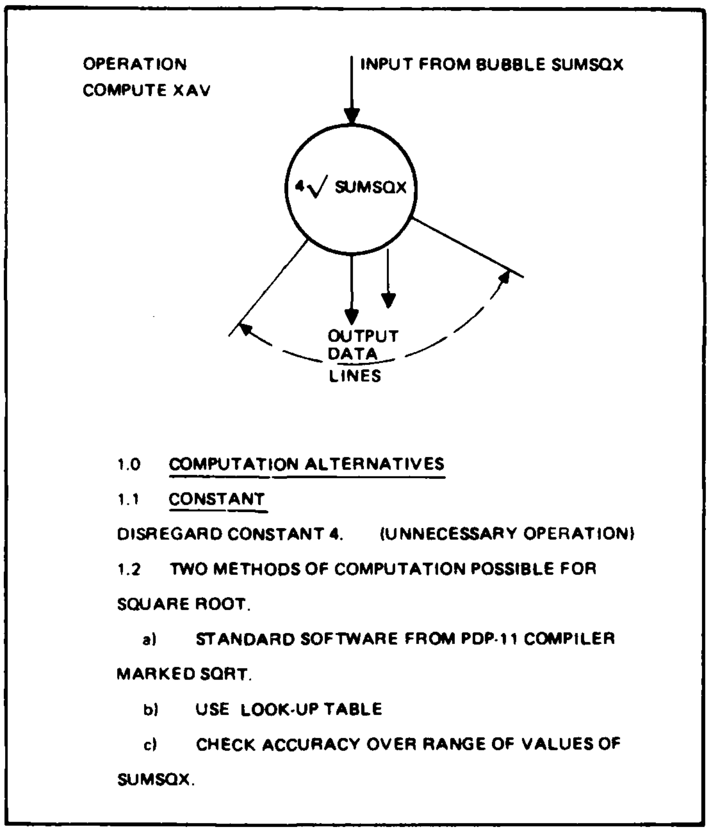


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Figure 2-5. Example, Detail Bubble XAV (Figure 2-4)

SECTION 3
TARGET SILHOUETTING SYSTEM

The output of the improved silhouetting system presented last quarter[1] may contain complete target silhouette regions, partial regions of other candidate targets, or clutter noise regions. In order to correct this deficiency, a connected region labeling and blob extraction processor has been developed and included in the target silhouetting system. The complete system will segment single or multiple candidate targets (hot targets or cold targets or both) within the subimage. It will then give the complete, clean, and clutter-noise-free texture silhouette(s) to the classifier.

This section will present an overview of the target silhouetting system along with details of the connected region labeling and blob extraction processor. Experimental results that used all of the available image data sets are also given. A final section summarizes the target silhouetting system and discusses the future work of developing a silhouetting system for the multilevel target cases.

3.1 OVERVIEW THE TARGET SILHOUETTING SYSTEM

The block diagram of the target silhouetting system is shown in Figure 3-1. This system contains the silhouetting system presented last quarter, plus the connected region labeling and blob extraction processor which was developed this quarter.

If the connected region labeling algorithm was placed after the threshold level selection processor, region labeling would have to be done at each trial threshold level resulting in many erroneous candidate regions, particularly at those threshold levels which are not near the optimum. Thus, the silhouetting system would need long processing times to label all regions and to compute figures of merit from each connected region. The whole silhouetting system would thus become very complex.

---

[1] B. Deal et al., Automatic Target Cuer Second Quarter Report, 1 December 1980

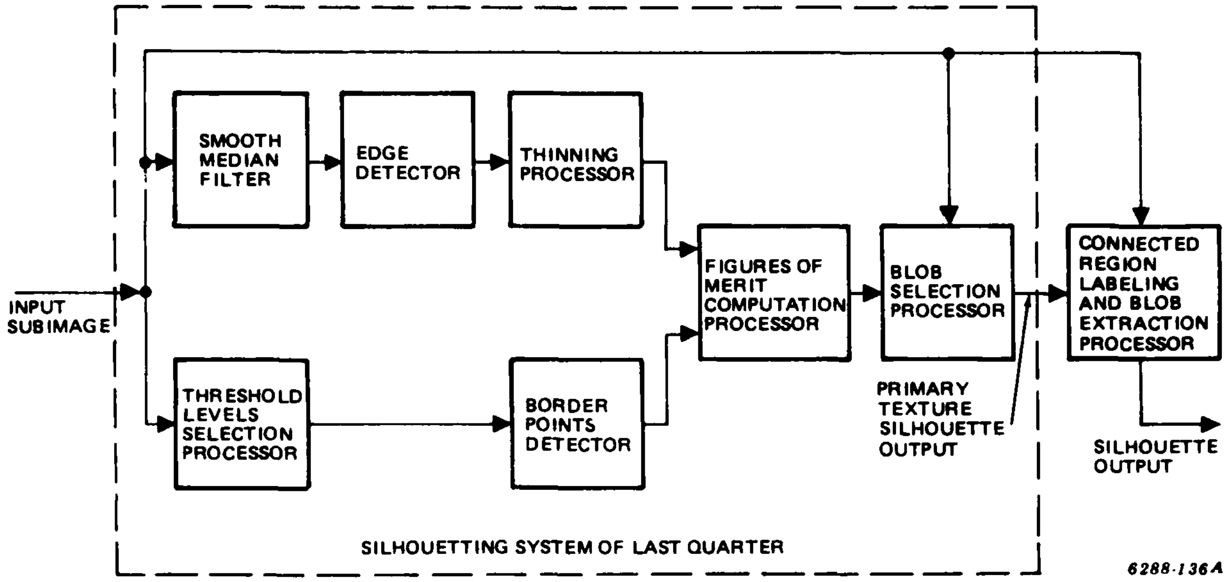

Figure 3-1. New Target Silhouetting System

When the label algorithm is placed after the blob selection processor, the algorithm must only color connected regions at the optimum threshold level. Thus, the connected region labeling algorithm is simplified and the output silhouette will accurately represent the true object boundary. The drawback is that the cold target silhouette will be missing if the subimage contains both complete hot and cold targets. The complete candidate target silhouette is defined as a closed region which has useful shape information for the classifier. Even if the silhouettes of all military vehicles are not distinguishable in this case, there is a need to recognize the candidate objects as targets or nontargets.

This new silhouetting system produced better performance than other techniques which were discussed in the last quarter. The connected region labeling and blob extraction processor adds to the capability to cope with multiple targets within the subimage.

3.2 CONNECTED REGION LABELING AND BLOB EXTRACTION PROCESSOR

A block diagram of the connected region labeling and blob extraction processor is shown in Figure 3-2. This processor contains a perimeter detector, region coloring processor, and an extraction processor.

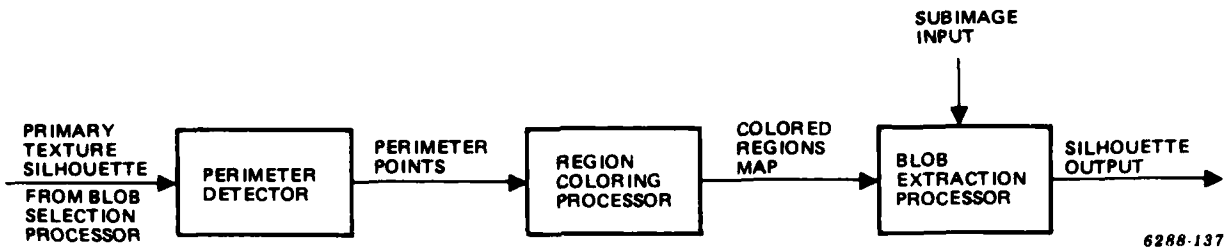

Figure 3-2. Connected Region Labeling and Blob Extraction Processor

The primary texture silhouette is the output from the silhouetting system. This texture silhouette is converted to a binary silhouette which is sent to the perimeter detector where perimeter points of the silhouetted regions are detected. The perimeter detector mask is as follows:

$$\begin{matrix} Z & Y & Z \\ Y & X & Y \\ Z & Y & Z \end{matrix}$$

"X" designates the examined pixel of the mask, the "Y's" are 4-connectivity adjacent pels, and the "Z's" are "don't care" pixels. This operation is applied in raster scan sequence, as each pixel is tested against the above mask. If for a non-zero "X" pel there is a "Y" pel with a zero value, then that "X" pel counts as a perimeter point; otherwise it is set to zero.

After the perimeter points are detected, it is necessary to aggregate perimeter points into labeled regions. The process which searches out and labels the individual disjointed regions in the binary silhouette image is called connected region labeling.

During a single raster scan the processor searches and groups together perimeter points that bound the same region in an image and then labels those regions. A detailed description of this algorithm follows:

When a perimeter point of a new region is encountered during a raster scan, it is assigned a color and also a stack register to store the feature values which describe the connectivity status of its eight adjacent points. The successor point is tracked in the order shown by the following mask:

6	7	8
5	X	1
4	3	2

Whenever the successor point is found, it is assigned the same label as the test point. The successor now becomes a test point and the search and labeling operation will continue until the successor reaches either a point which it has already visited, the last point of the region, or the boundary point of this subimage. Since the successor of each test point may have as many as eight points, the entire operation may need to be performed more than one time. The feature values stored in the stack registers will provide information indicating where and when the successor needs to search and label. The region labeling process is performed continuously in raster scan sequence until the end of the subimage.

The blob extraction processor eliminates the clutter-noise regions and extracts the individual completely ringed region as a silhouette output to classifier. The clutter-noise regions are defined as (1) small regions (area ≤ 9 pels) or (2) regions whose ratio of perimeter points to subframe boundary points is greater than 10 percent. By prescreening the output of the target silhouetting system in this fashion, a single, clean silhouette is obtained.

The connected region labeling and blob extraction process is best illustrated by the experimental results shown in Figure 3-3. "Original image" denotes the original primary silhouette which has one object, along with five clutter objects, attached to the boundary of the subimage. "Perimeter color labels" denotes the output of the perimeter detector and the numbered objects denote the individual silhouette outputs.

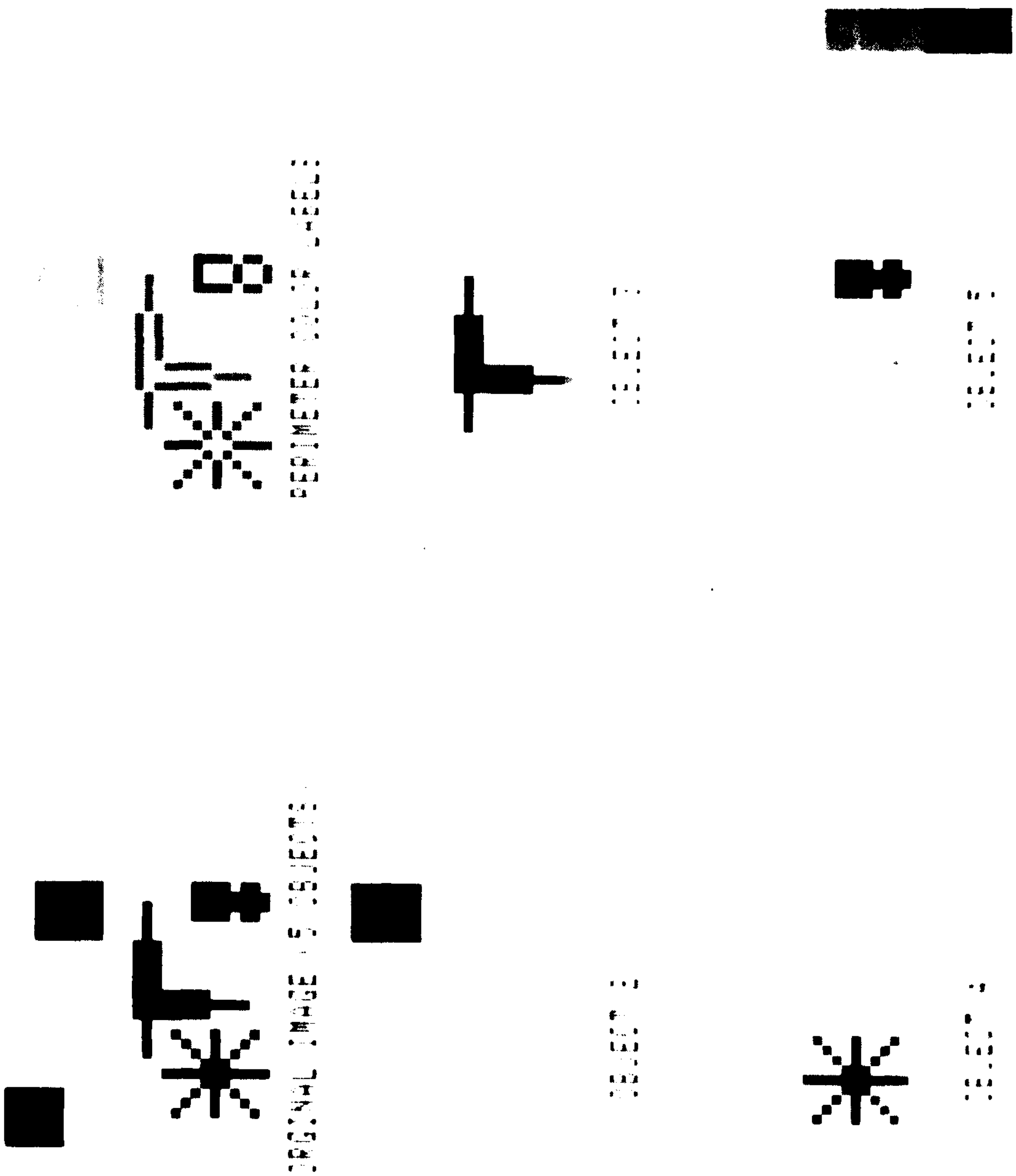

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Figure 3-3. Result of the Corrected Region Labeling and Blob Extraction Processor

3.3 IMPLEMENTATION AND EXPERIMENTAL RESULTS

The implementation of the silhouetting system is the same as that described in the last quarterly report except the selection of threshold levels is increased to 14 levels from 8 levels. The connected region labeling and blob extraction processor is implemented as described in the last section. Experiments were made using samples from the Fort Polk, Alabama, A.P. Hill, ERIM, Graff II, and Hunter-Liggett data sets. These data sets contain hot targets, cold targets, or both. The experimental results are shown in Figure 3-4, where "original" denotes original input subimage, "primary" denotes the primary silhouette output from the improved silhouetting system, "hot-cold" denotes the output of hot-cold indicator, and "textured extract" denotes extracted texture silhouette output.

3.4 SUMMARY

The target silhouetting system has been developed and implemented. Experimental results using samples from all available data sets have been presented. From these experimental results, the following observations can be made:

a. This system produced proper silhouettes, both in high contrast and low contrast subimages

b. The output silhouette(s) have no clutter noise regions

c. This system works well for hot targets and cold targets

d. This system also works very well in the multiple targets case.

EXAMPLE A

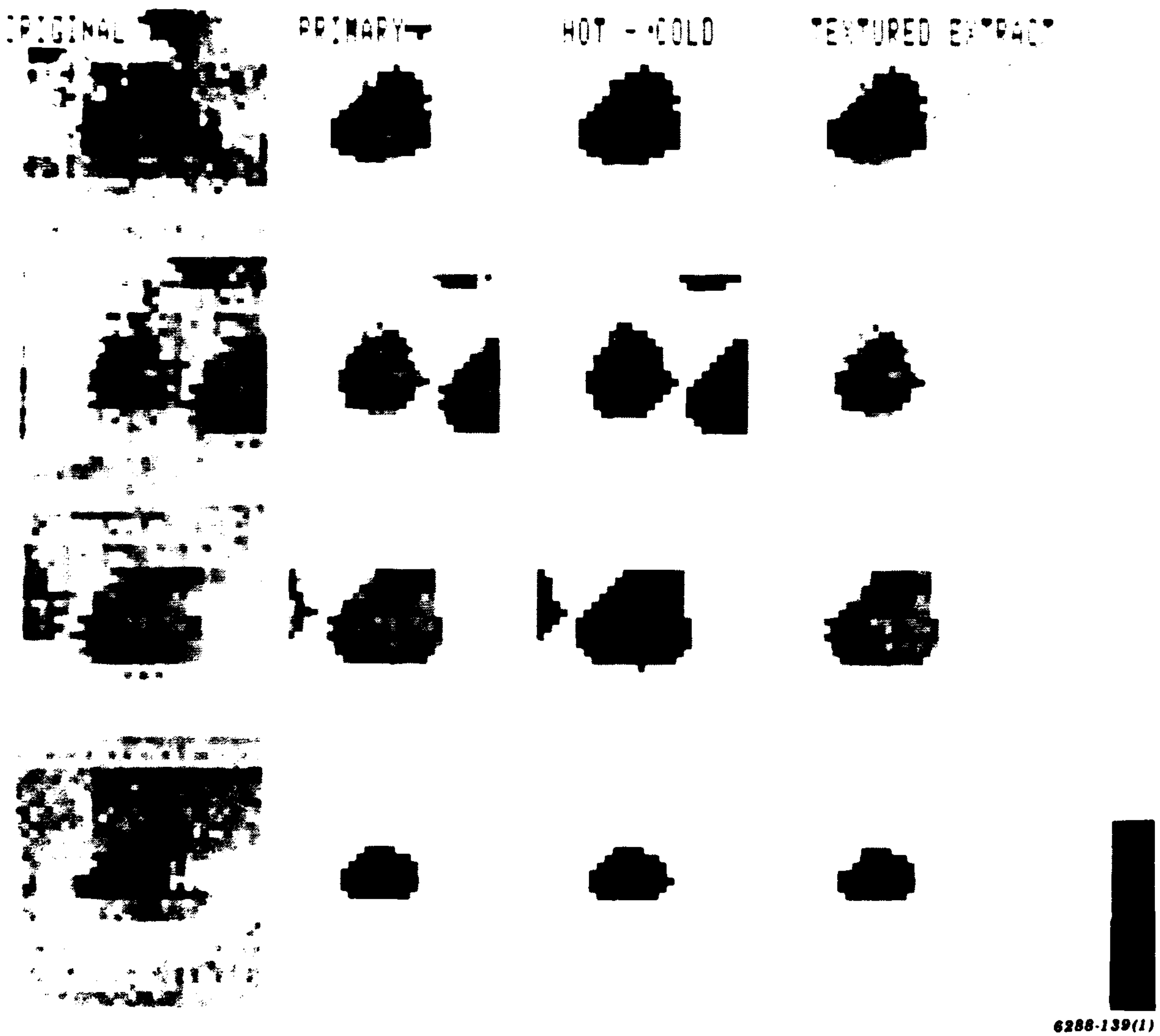

Figure 3-4. Examples of Silhouette System Performance (Sheet 1 of 13)

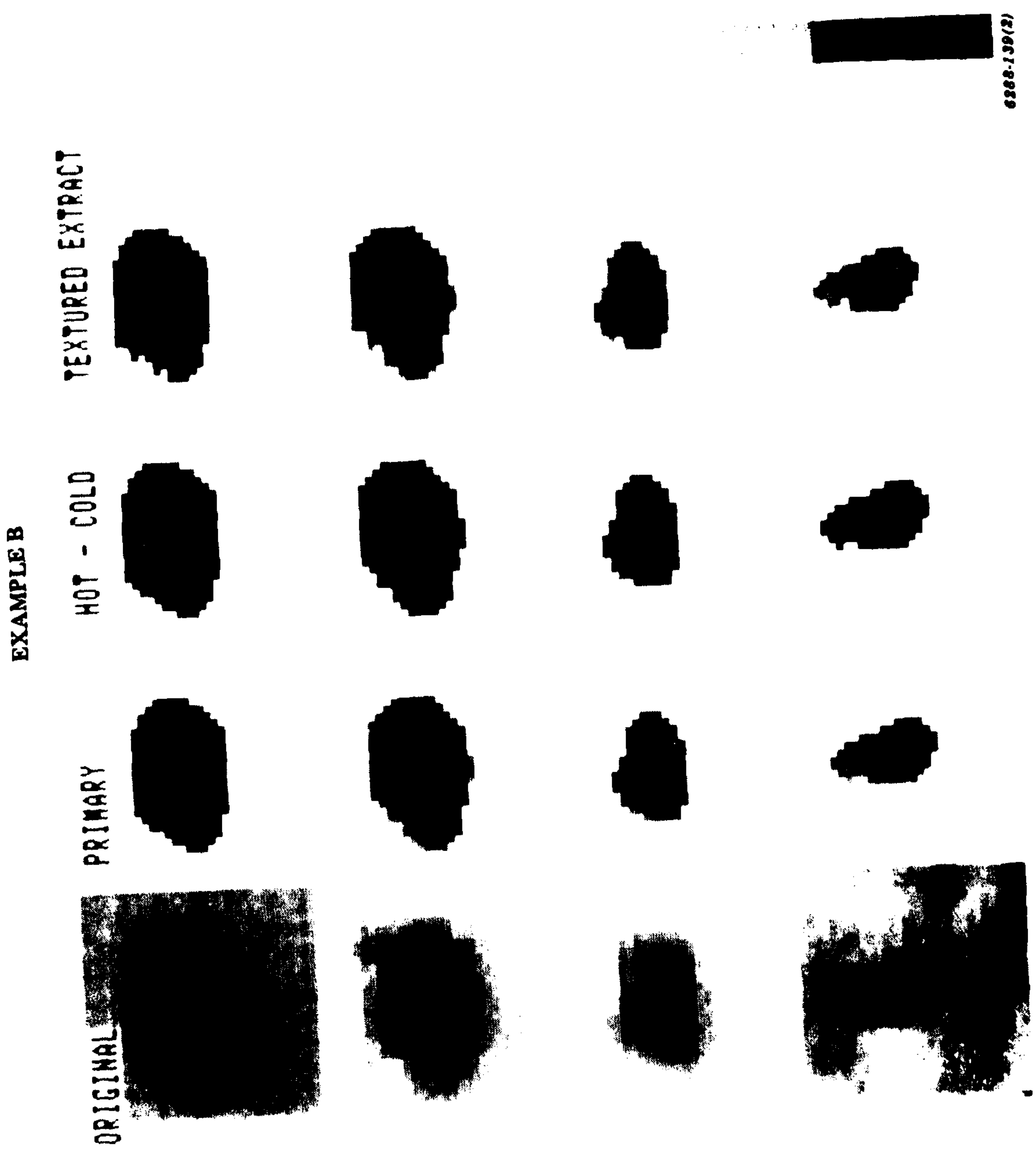

Figure 3-4. Examples of Silhouette System Performance (Sheet 2 of 13)

EXAMPLE C

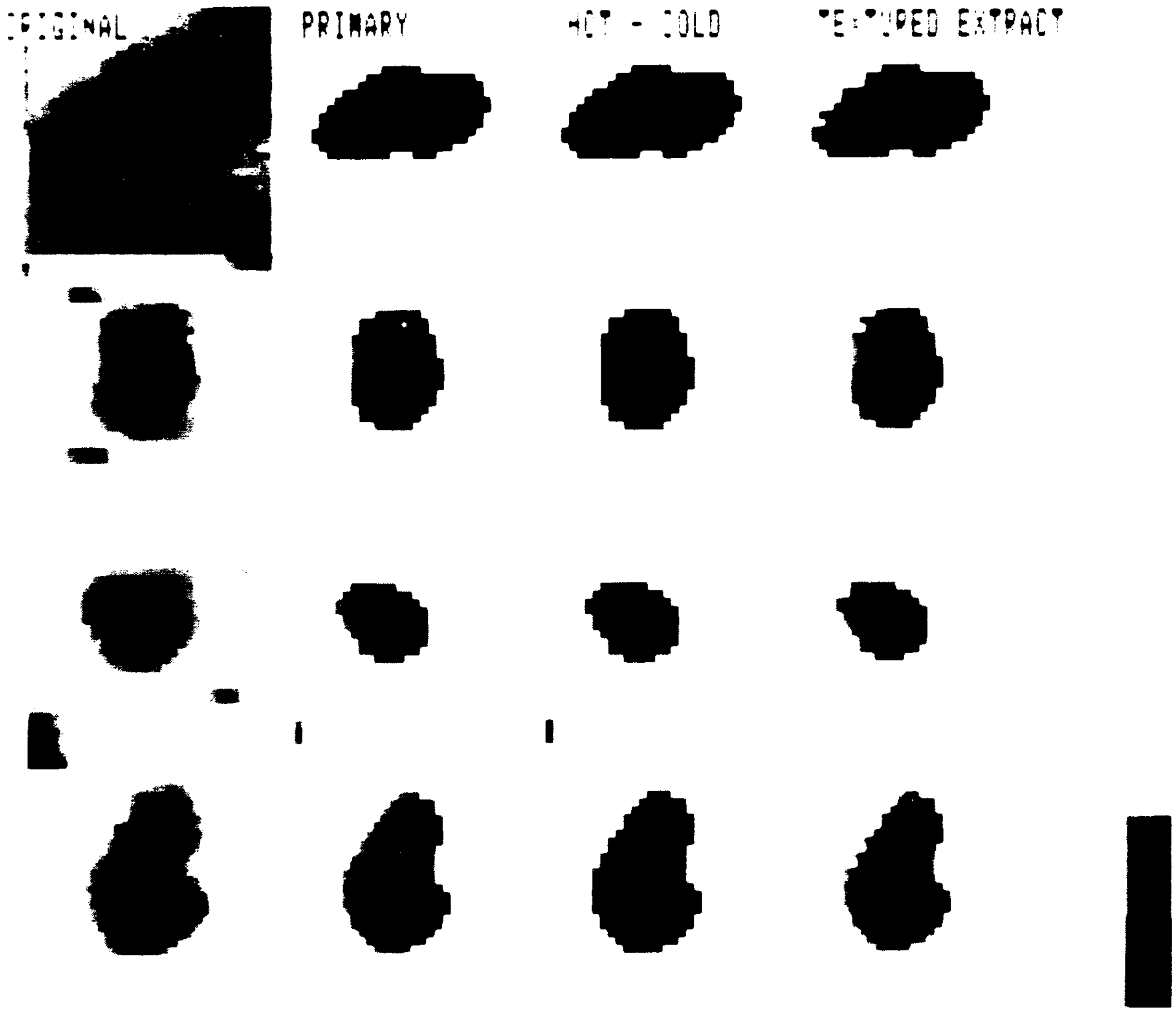

Figure 3-4. Examples of Silhouette System Performance (Sheet 3 of 13)

EXAMPLE D

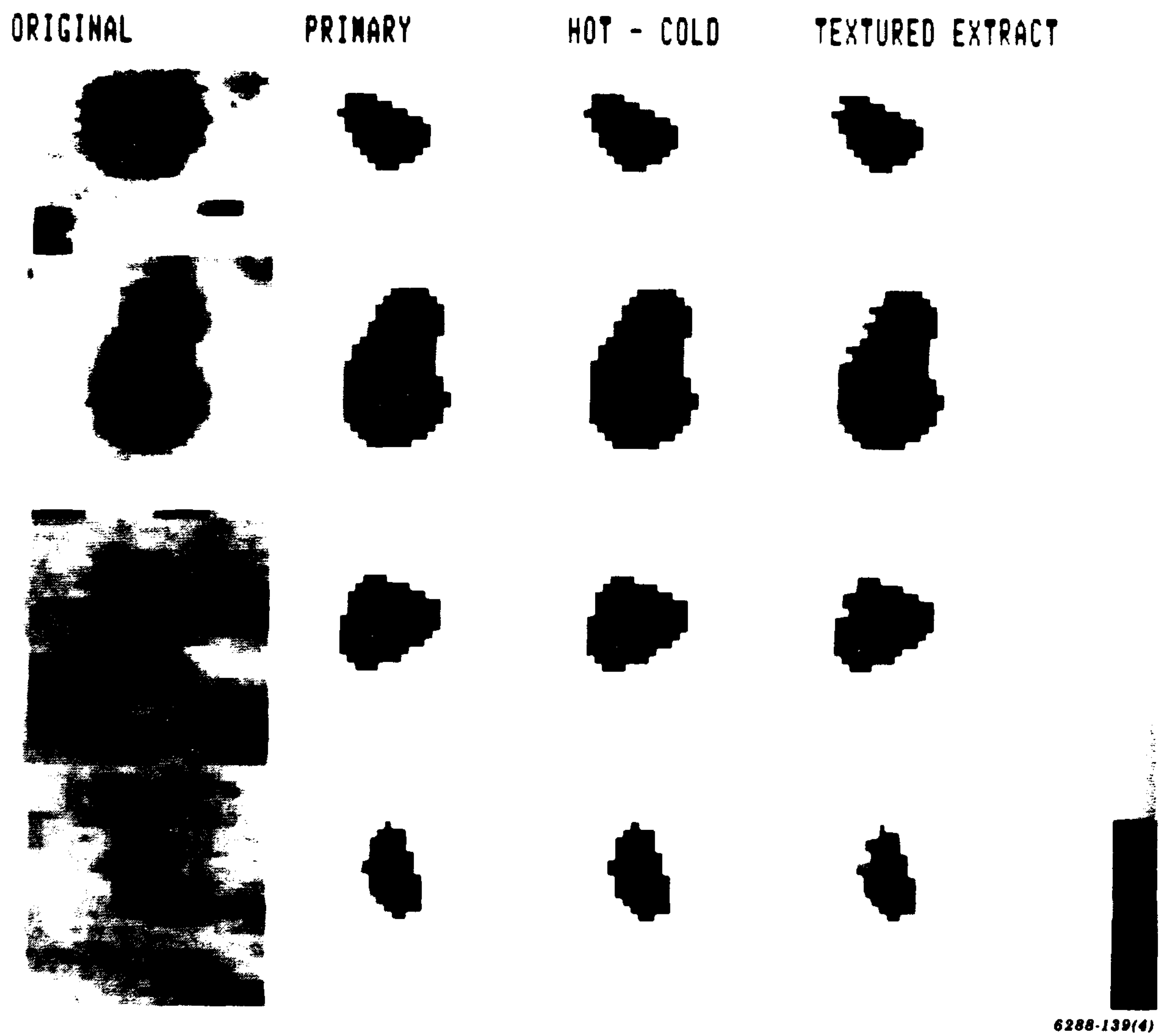

Figure 3-4. Examples of Silhouette System Performance (Sheet 4 of 13)

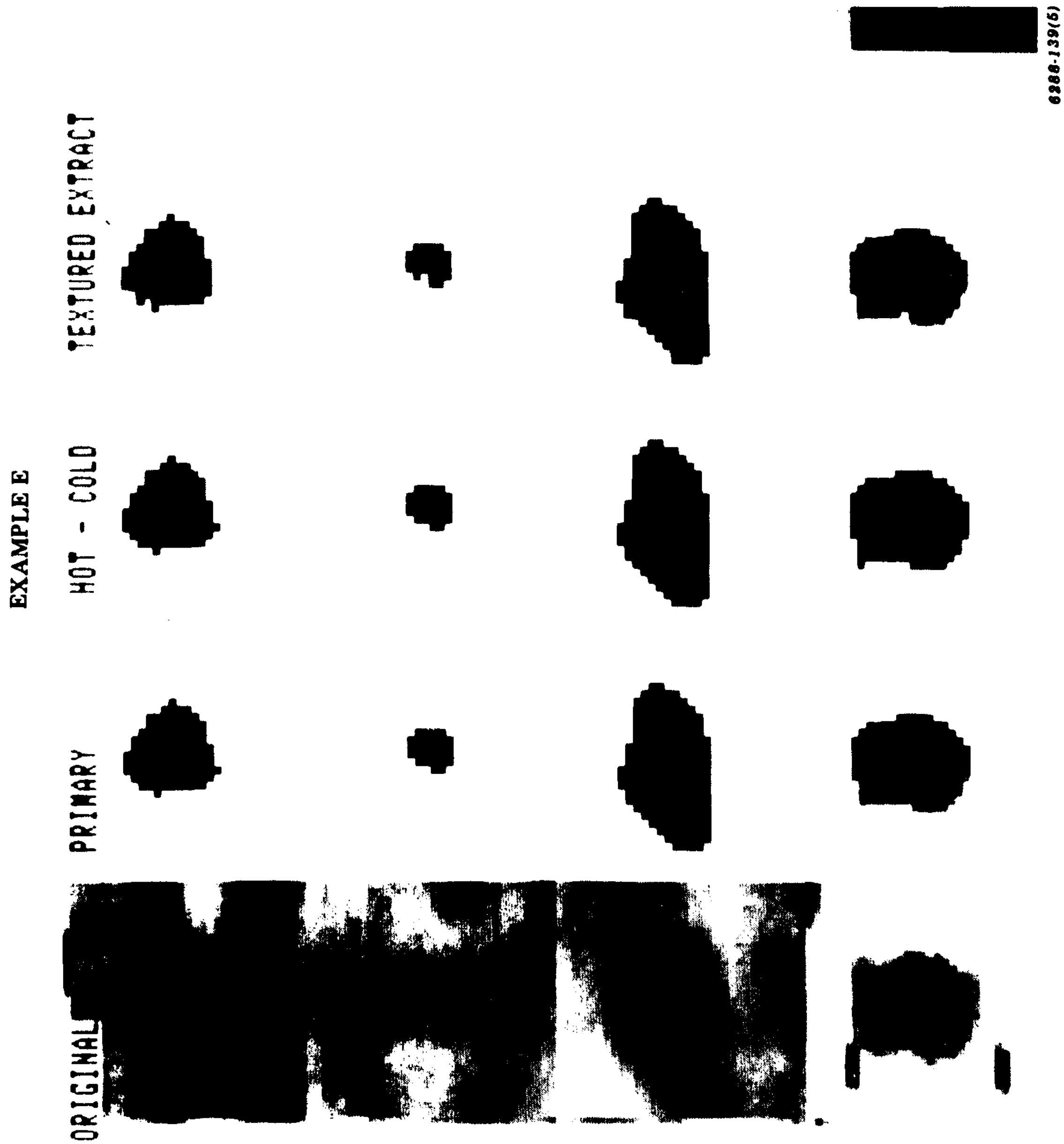

Figure 3-4. Examples of Silhouette System Performance (Sheet 5 of 13)

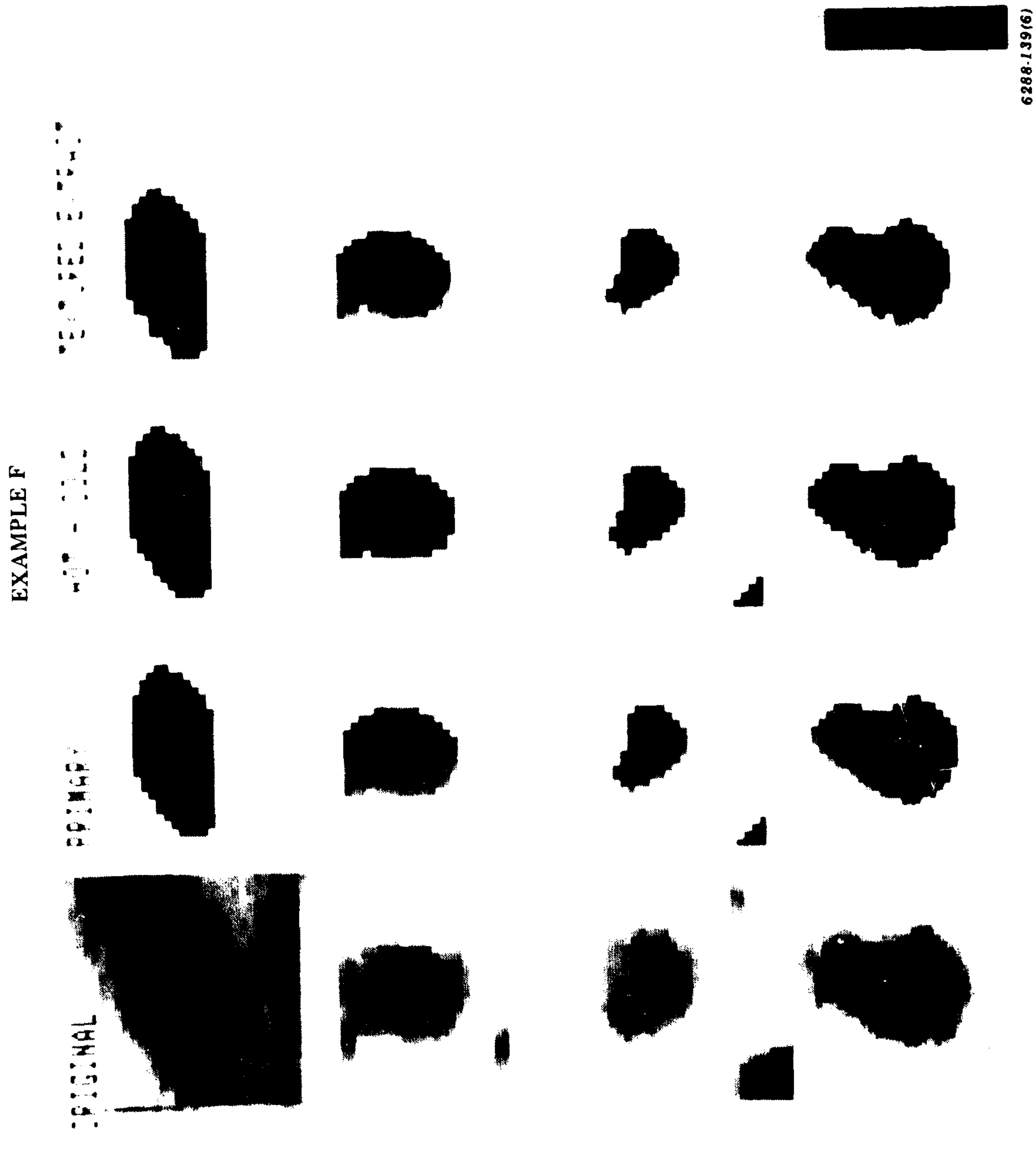

Figure 3-4. Examples of Silhouette System Performance (Sheet 6 of 13)

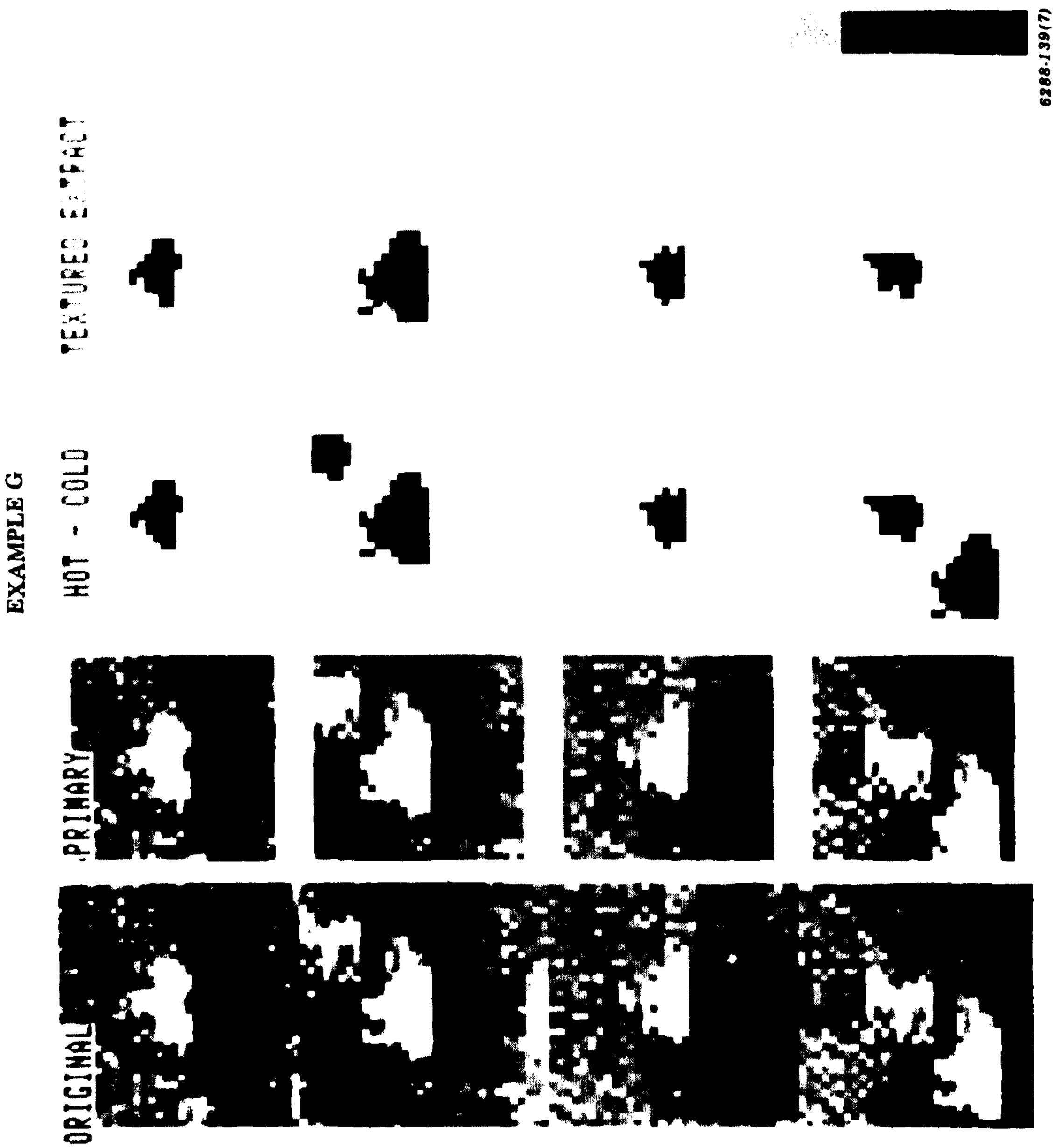

Figure 3-4. Examples of Silhouette System Performance (Sheet 7 of 13)

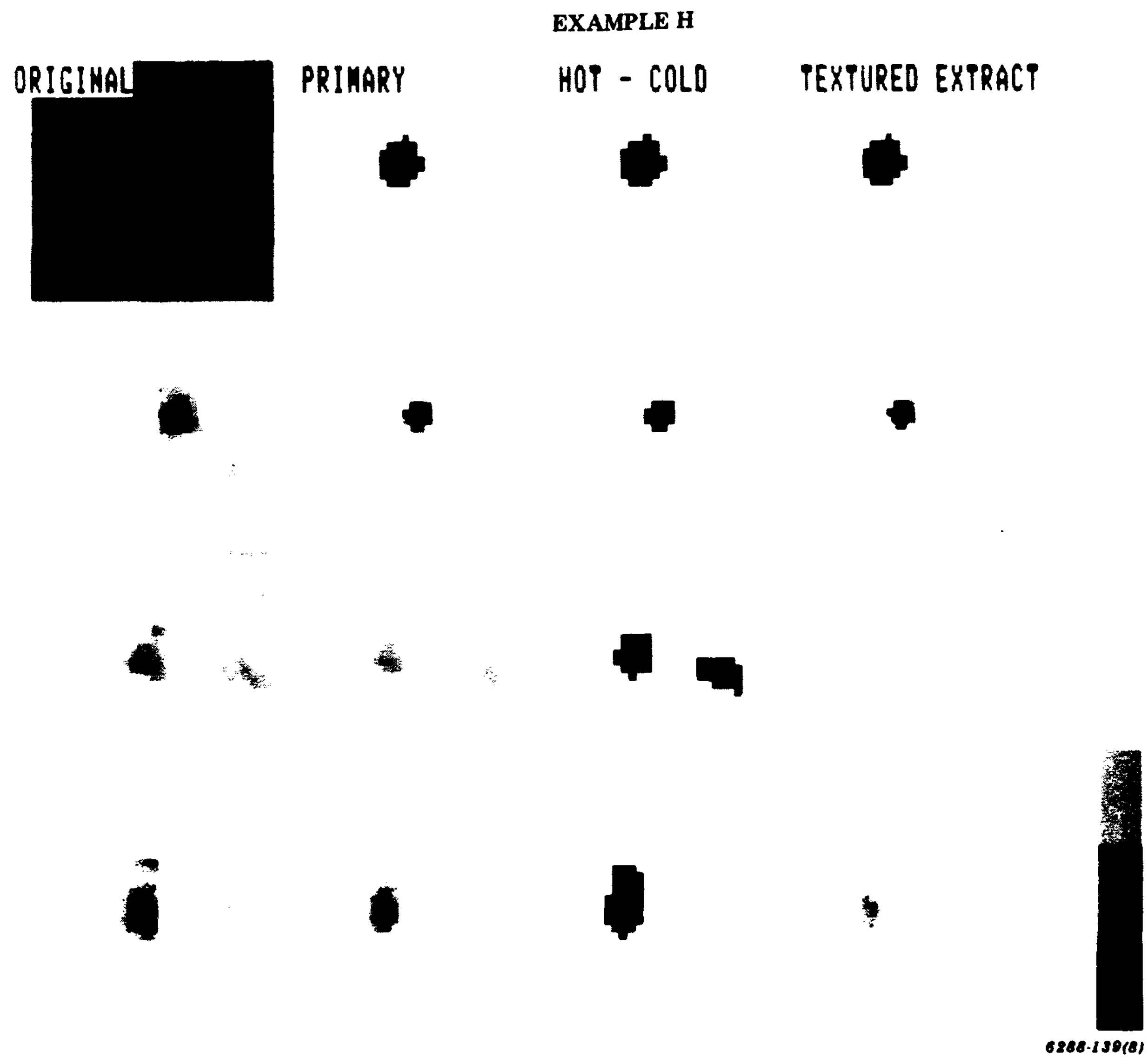

Figure 3-4. Examples of Silhouette System Performance (Sheet 8 of 13)

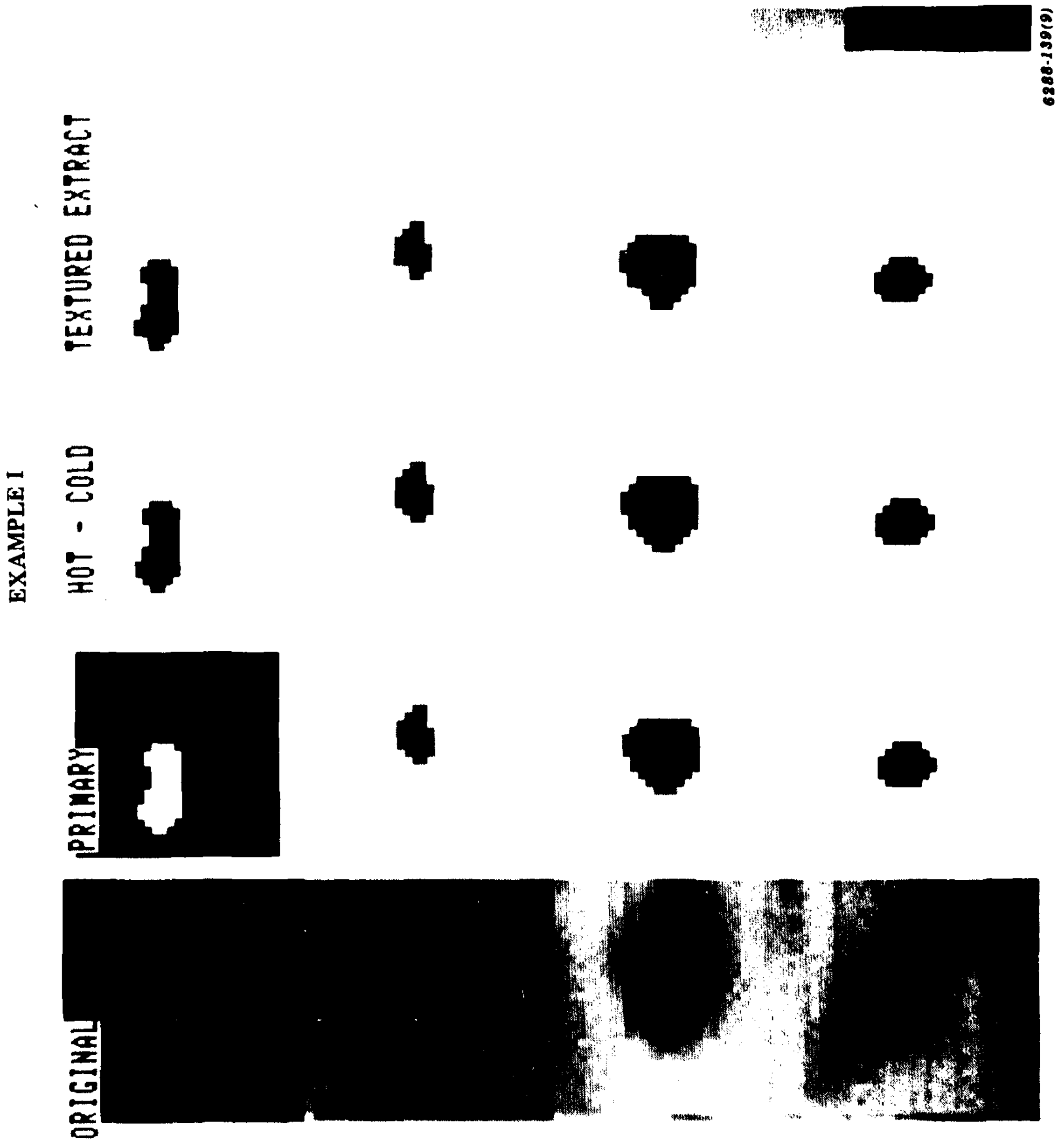

Figure 3-4. Examples of Silhouette System Performance (Sheet 9 of 13)

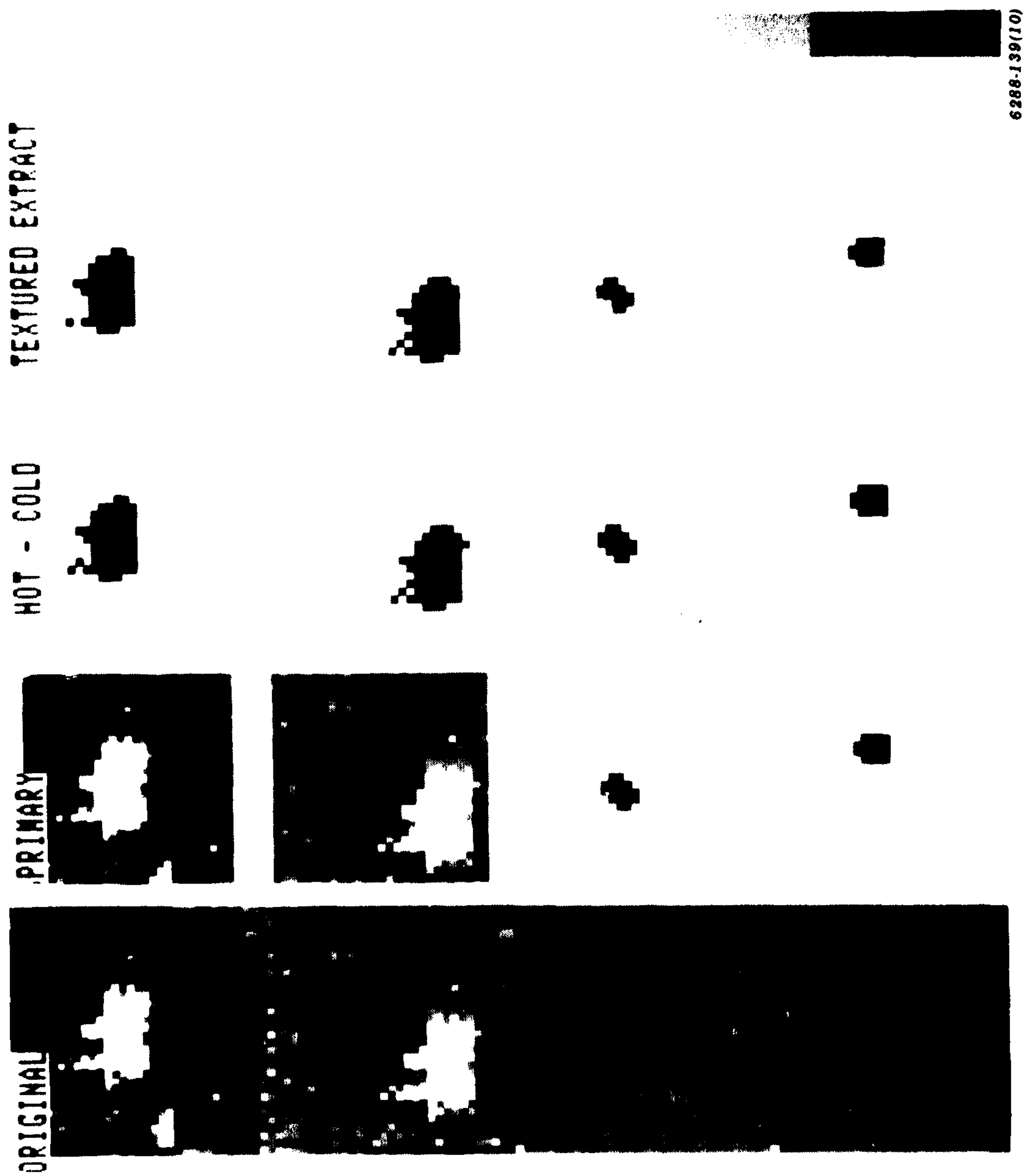

Figure 3-4. Examples of Silhouette System Performance (Sheet 10 of 13)

EXAMPLE K

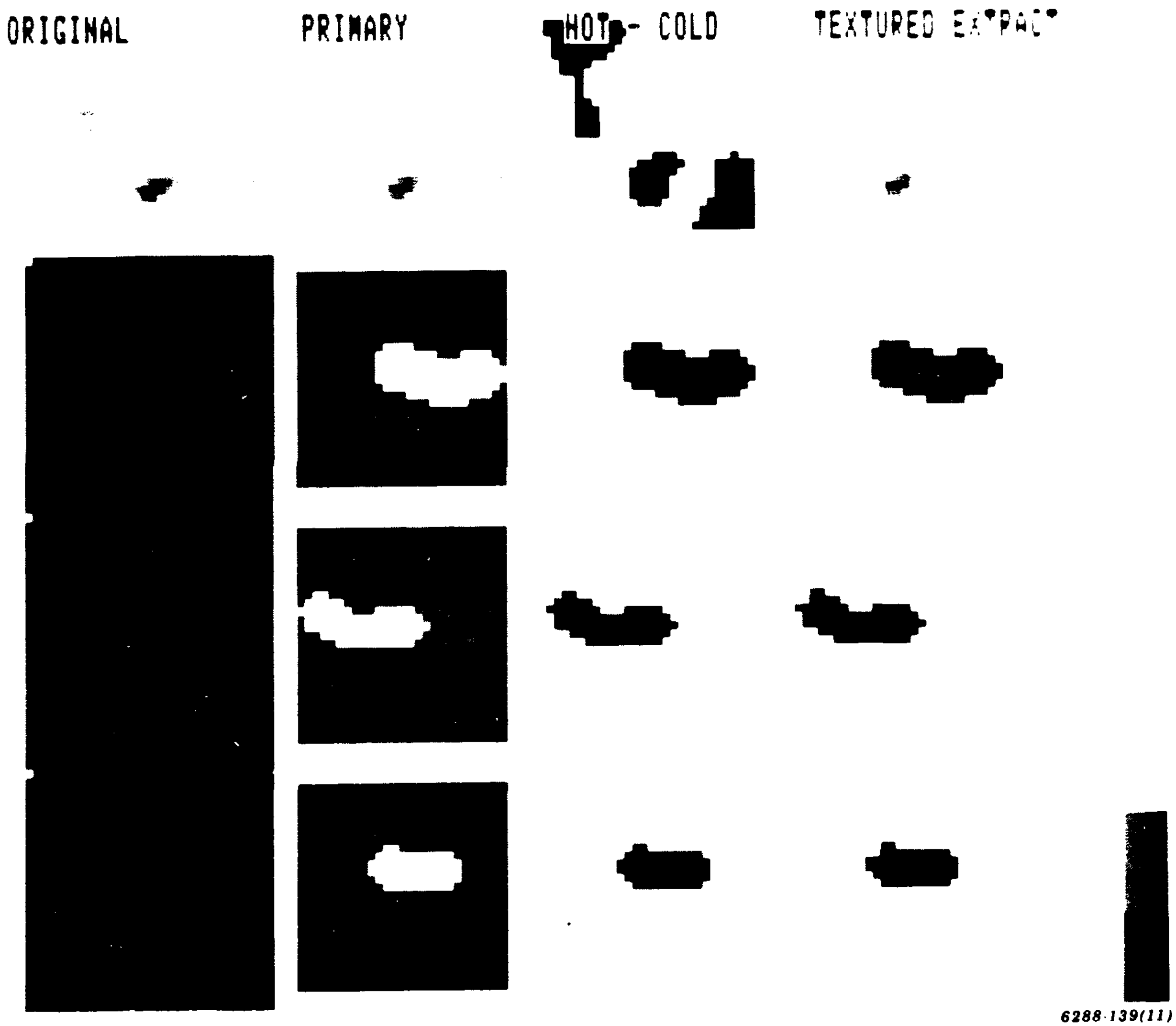

Figure 3-4. Examples of Silhouette System Performance (Sheet 11 of 13)

EXAMPLE L

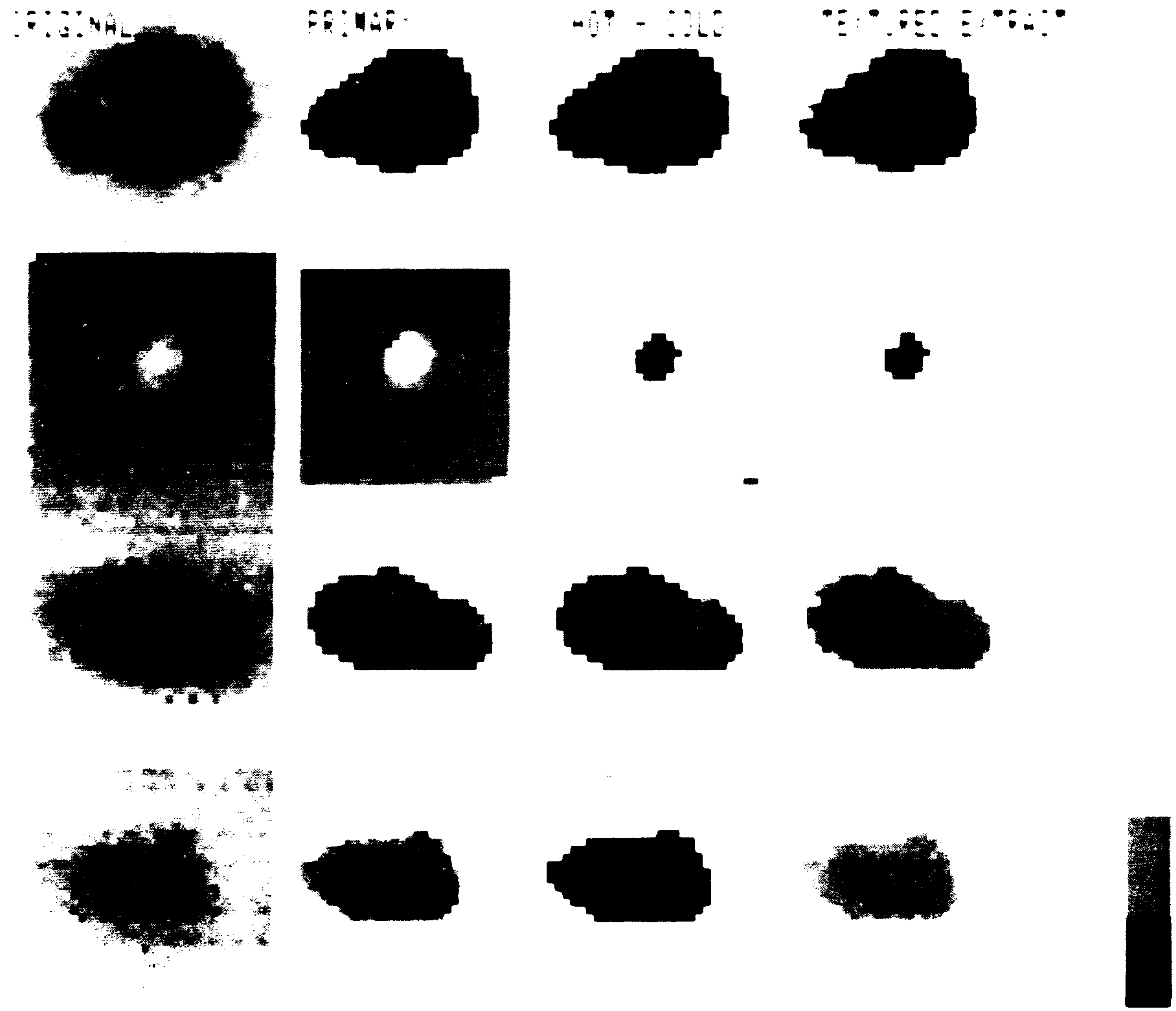

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Figure 3-4. Examples of Silhouette System Performance (Sheet 12 of 13)

EXAMPLE M

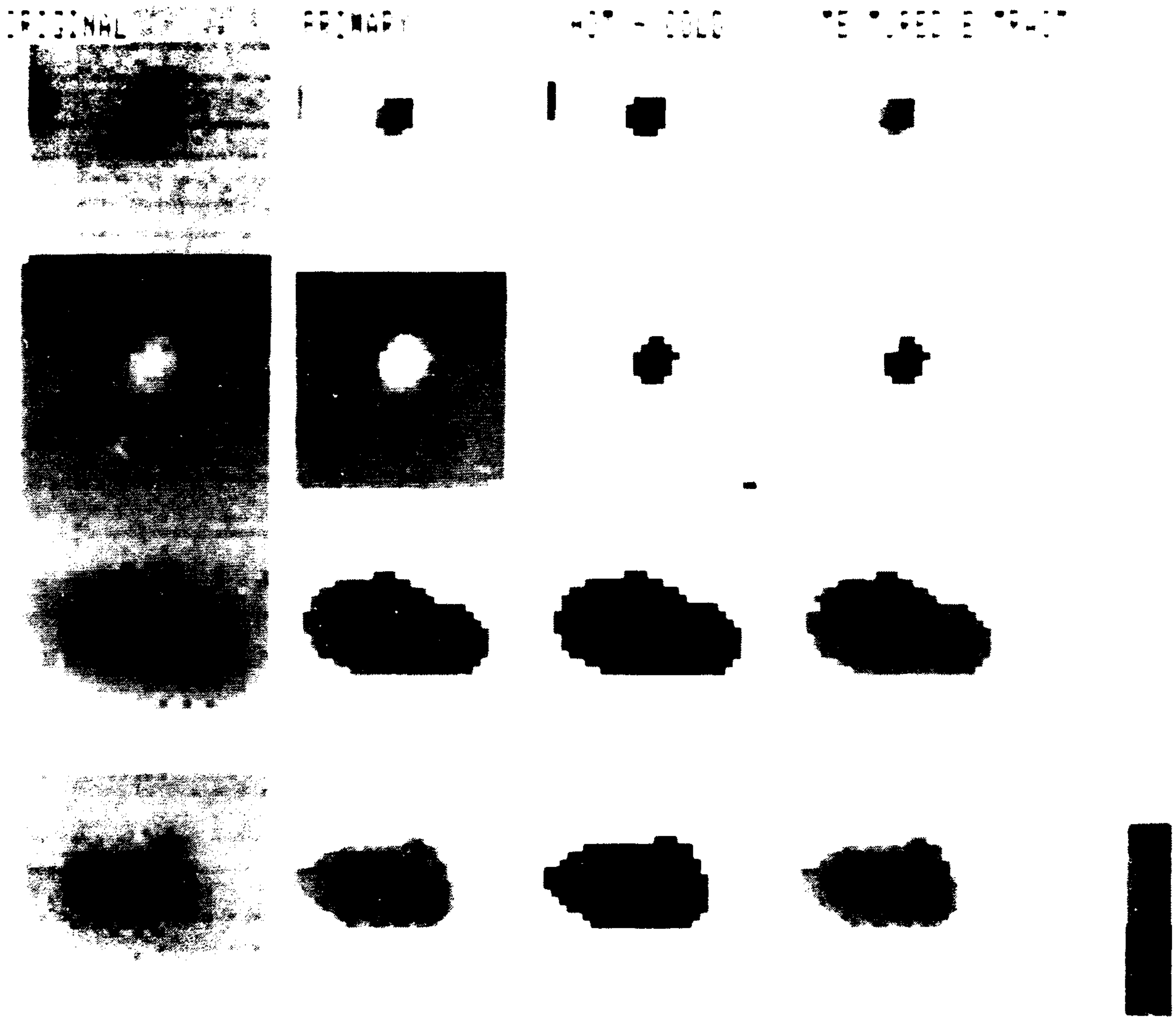

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Figure 3-4. Examples of Silhouette System Performance (Sheet 13 of 13)

SECTION 4
INTERFACE BUFFER/ANTI-ALIASING FILTER

The need for an interface buffer between the FLIR postamplifier and the electronic multiplexer was discussed in the first quarter report[1]. The need for some form of anti-aliasing filtering was also addressed. Both of these requirements have been met by implementing a two-stage amplifier, each stage of which is a two-pole, low-pass filter. The two stages have a combined maximum gain of 10 with a gain control between the two stages. Additionally, an offset adjustment is provided which allows introduction of dc offset, either positive or negative, into either amplifier. These adjustments are implemented with trimpots and will facilitate the interfacing of the FLIR with the multiplexer.

Each stage of the amplifier is an active filter with a transfer function of the form:

$$\frac{e_o}{e_i} = \frac{H W_o^2}{S^2 + \alpha W_o S + W_o^2}$$

The first stage has a slight boost ($\alpha = 1$) and results in the bandpass curve 1 (Figure 4-1). The second stage is maximally flat ($\alpha = \sqrt{2}$), resulting in curve 2. The α and f_o for each stage were selected to have the least effect on the overall Modulation Transfer Function (MTF) while attaining attenuation of frequencies above a detector cutoff of at least 46 dB, the desired system dynamic range. The resulting net MTF curve shown in Figure 4-1 includes the effects of the FLIR electronics, the detector, and both filter stages.

The filters have been implemented using standard operational amplifiers and discrete components. Eight filter channels occupy one circuit card in the FLIR digitizer unit[2]. A filter implementation that will occupy less volume is currently being investigated and will be reported during subsequent quarters.

---

[1] B. Deal et al., Automatic Target Cuer First Quarter Report.

[2] B. Deal et al., Automatic Target Cuer Second Quarter Report.

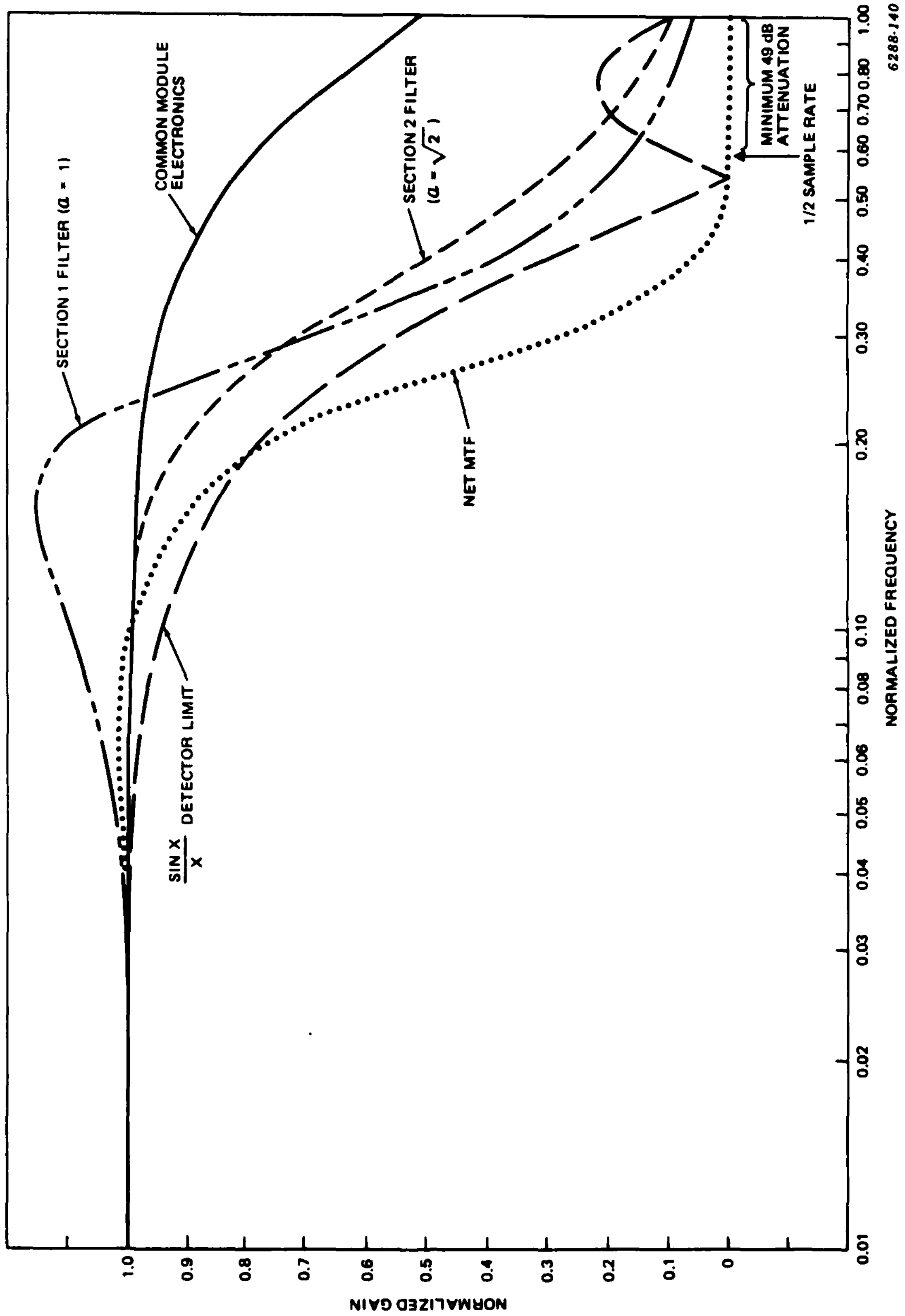

Figure 4-1. Interface Buffer/Anti-Aliasing Characteristics

SECTION 5
DATA BASE DESIGN

With the installation of large disk peripherals on our laboratory computer, it has become possible to store all current NATO-formatted target imagery (previously available only on tape) in a randomly accessible form on-line, and convert all ground truth variables also to a randomly accessible form on-line. This conversion will facilitate cross-tabulations and image selection directly, using any simple or complex selection rule.

The data base was designed for:

a. Simplicity of format
b. Minimum of directory overhead
c. Economy of storage space consistent with a simple format.

5.1 FORMATS

There are two tables constituting the data base directory:

a. Picture Identification Table (PID)
b. Picture Pointer Table (PPT).

In addition, each picture stored in the data base has a control table:

a. Picture File Header (PFH)
b. Image File.

This structure is shown pictorially in Figure 5-1.

5.1.1 Picture Identification Table

The PID has an entry for each image stored in the data base. The entry uniquely identifies where the image came from, including:

a. The source tape
b. The relative file number of the image on the tape
c. The segment number.

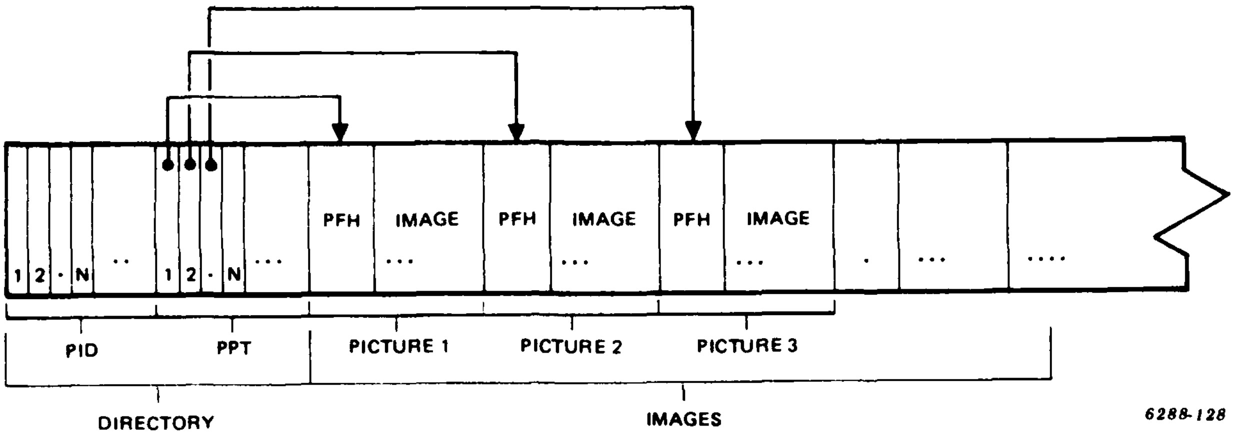

Figure 5-1. Data Base Format

This table facilitates searching for particular images without having to read the entire data base.

5.1.2 Picture Pointer Table

The PPT consists of a list of logical disk addresses, one such pointer per image stored in the data base. In the current implementation, 400,000 physical 4,096-bit disk sectors have been reserved, making room for about 780 (512 by 512 by 8 bit) images.

The PPT increases the disk storage density by permitting images of varying size to be packed by sequential sector address.

5.1.3 Picture File Header

The PFH is the first record of every image. The PFH is a 512-byte record with 31 items identified. The following list describes each of the 31 items.

1. Unique picture number in data base (1 to about 1,500)
2. Number of things ground-truthed to date (0 to 30)
3. Source tape identifier (a lab specific numeric identifier)
4. Tape originator identification (e.g., ALA 1 8)
5. Picture's position on the tape (e.g., file number)
6. Segment number, if any (0 = whole image; otherwise 1, 2,...N for N segments

7. X-offset if segmented (relative to tape image)
8. Y-offset if segmented (relative to tape image)
9. Total number of columns in this picture
10. Total number of rows in this picture
11. Time of day of the picture (0 to 2400)
12. Sensor spectral range: low end (e.g., 2.4 micrometers)
13. Sensor spectral range: high end (e.g., 5.7 micrometers)
14. Target range in meters
15. Platform altitude in meters
16. Polarity (1=white hot, 2=black hot)
17. Date of last update (DD-MM-YYx) 9+1 bytes
18. Time of last update (HH-MM-SS) 8 bytes
19. Unassigned area
20. Minimum pel value (actual)
21. Maximum pel value (actual)
22. Stated minimum pel value of image
23. Stated maximum pel value of image
24. Original significant range of sensor
25. Sensor stretch factor (e.g., picture dynamic range/sensor dynamic range)

The following items comprise the first "thing" code. There is provision for up to 30 "thing" codes per picture.

26. ASCII "thing" label for ground truth (e.g., tank, jeep)
27. First qualifier for target's aspect (e.g., side, front)
28. Second qualifier for multiple targets, or bad pel lines
29. X-coordinate of "thing's" center
30. Y-coordinate of "thing's" center
31. "Thing's" diameter.

For items 11 through 23 a "0" is stored if not known.

5.1.4 Image File

Each pel of an image is stored in unsigned 8-bit format. For conceptual convenience, a constant space is reserved for 512 pels per image line. One such line is exactly one physical sector in length.

5.2 GROUND TRUTHING

The "thing" codes in every PFH are generated by the program "TRUTH." The program first reads in a picture from the data base, and displays it on the video monitor as in Figure 5-2. After the picture is plotted on the TV screen the user is asked to move the cursor to a location of interest on the picture such as a potential target. After a point has been located, a 90 by 90 square surrounding the point is plotted on the screen magnified by a factor of 2 (2X rows x 2X columns) or more, and locally enhanced to facilitate observing detail (Figure 5-3). At this time, the user is asked if ground truthing is required or if further magnification is needed. In the example, a portion of the segment is chosen for further enlargement and is displayed as shown in Figure 5-4.

To ground-truth an object, the operator is asked for the name of the object in six ASCII characters or less. Then two numeric qualifiers are input to identify the aspect, the possibility of multiple targets, or other subcategory as required. The user input data is shown in Figure 5-5. At each stage of input, the user is asked if the prior response was accurate. When the entire process is complete for one object, the operator is asked if there are more objects to be ground truthed or if the process is complete for that particular image. The results are then stored in the data base PFH.

In addition to targets of interest, the process of ground-truthing includes other visually obvious features of the data base imagery such as clouds, trees, roads, horizon detail, etc. An enlarged subframe of one of these things is shown in Figure 5-6.

5.3 DATA BASE FORMATTING

Data base formatting is accomplished as shown in Figure 5-7. The goal of this effort is to read an NV&EOL supplied tape and convert it to target data base format.

Program MTIMAG reads an entire NATO tape file and creates two disk scratch files. The first file contains the picture file header and the second file contains the image. The operator inputs the tape number, number of images per tape, and the desired file. The image in that file is located on the tape and the operator inputs the following file header information from the free field tape header data:

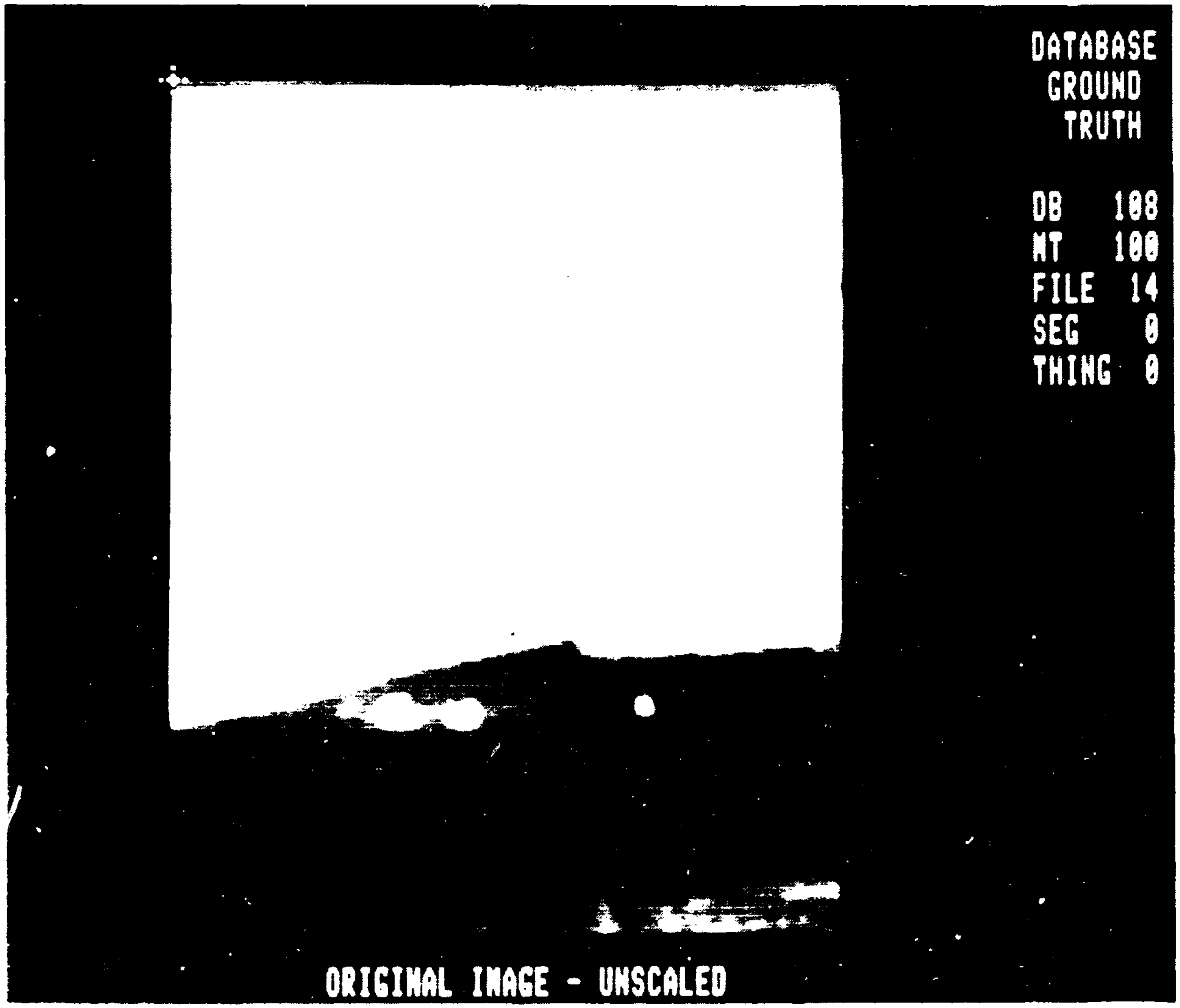

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Figure 5-2. Original Image

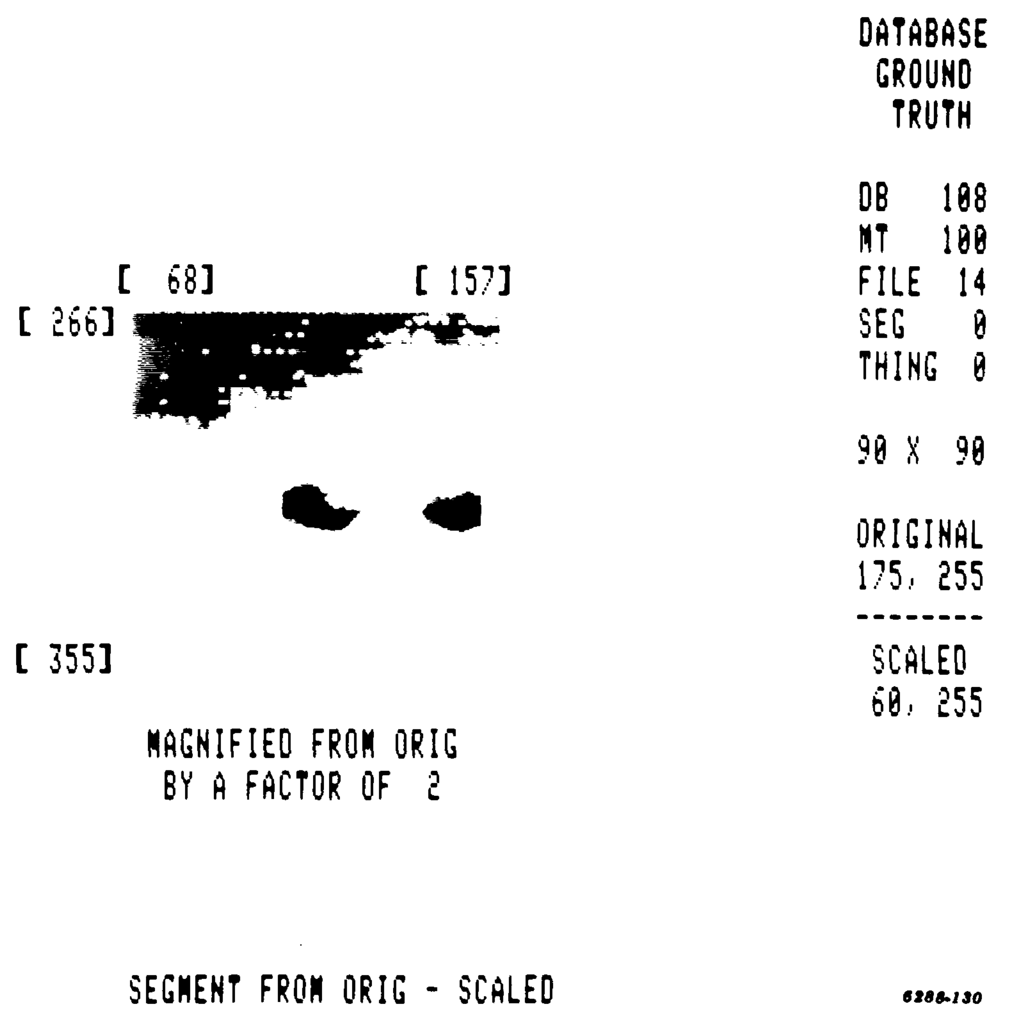

Figure 5-3. Two-Power Magnified Target Region

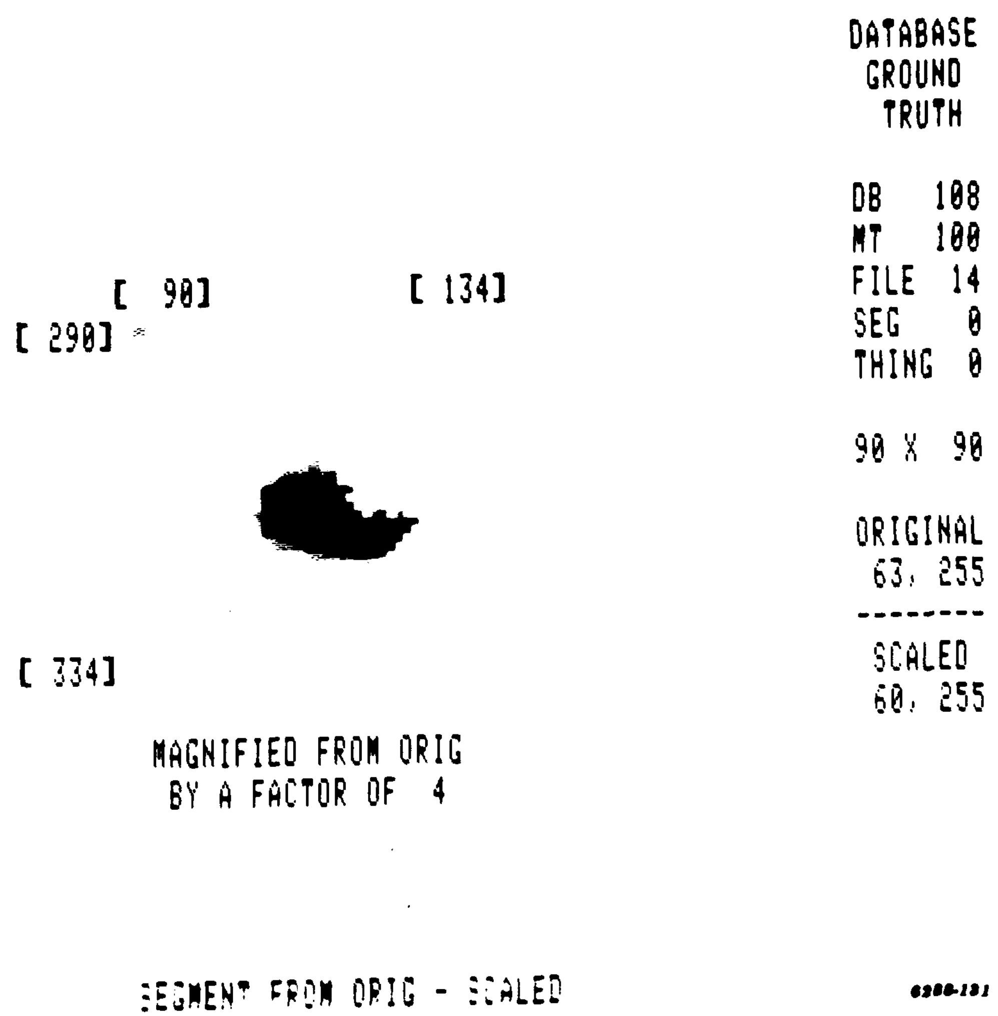

Figure 5-4. Four-Power Magnified Target Region

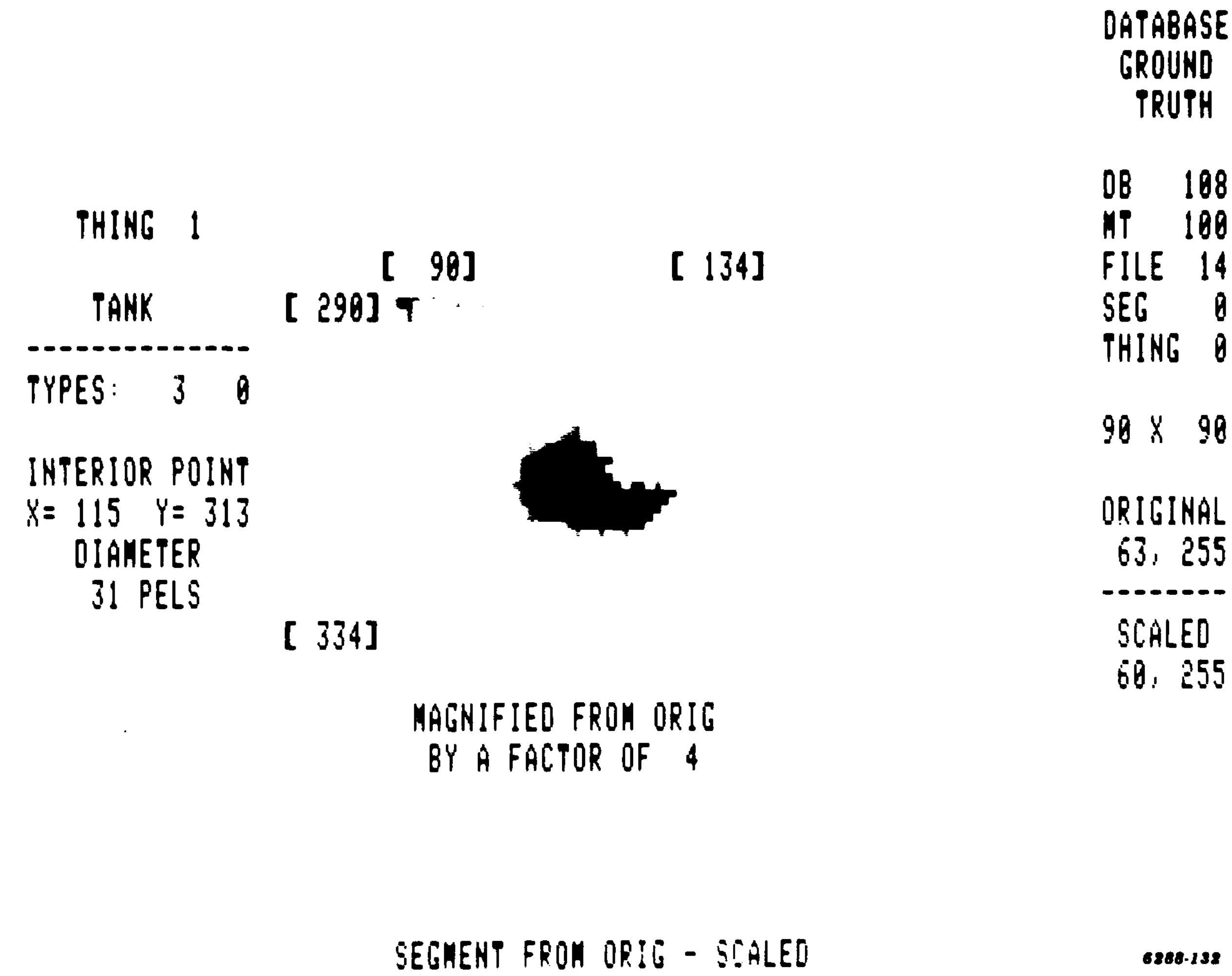

Figure 5-5. Target Region With Ground Truth Display

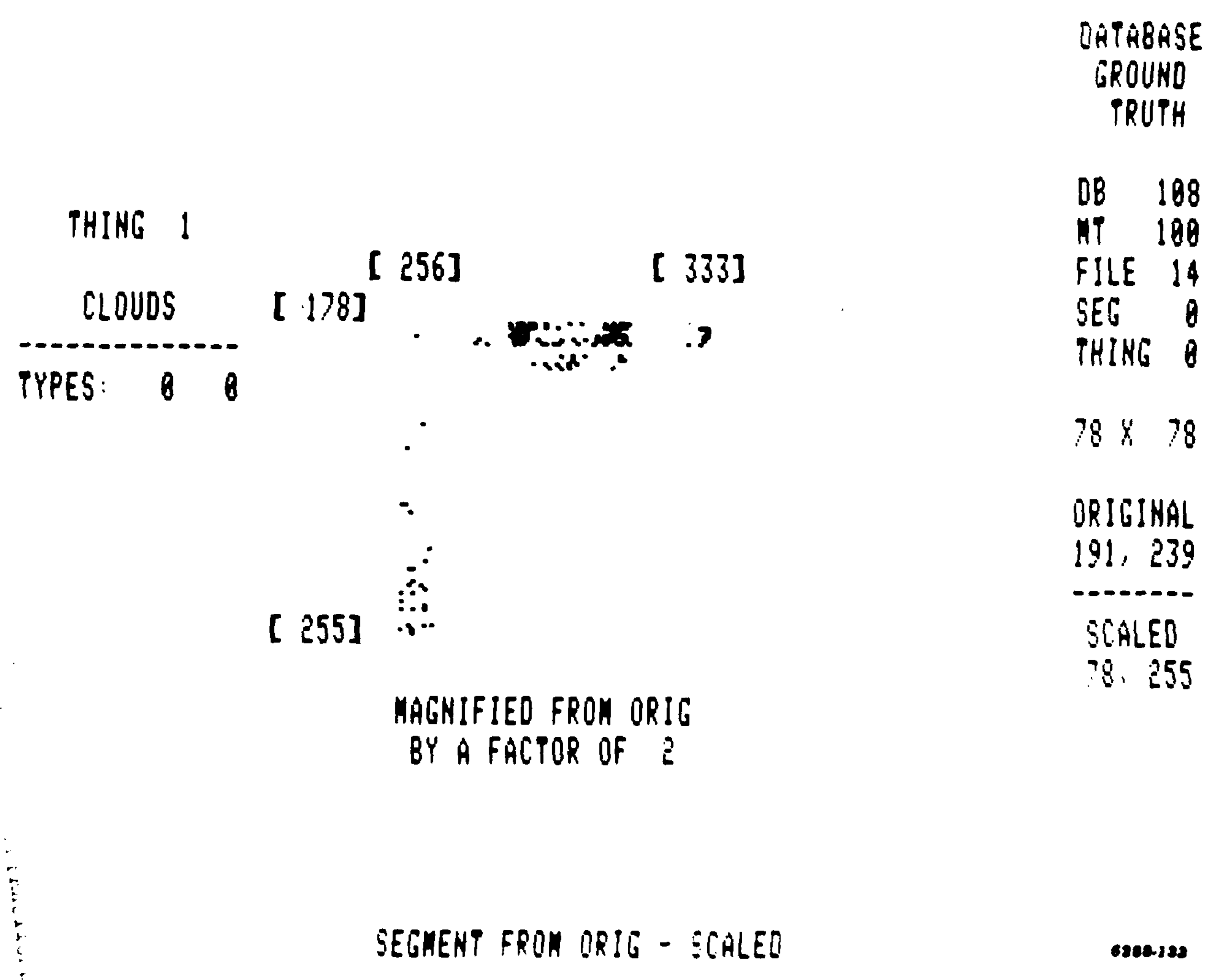

Figure 5-6. Enlarged Cloud Region

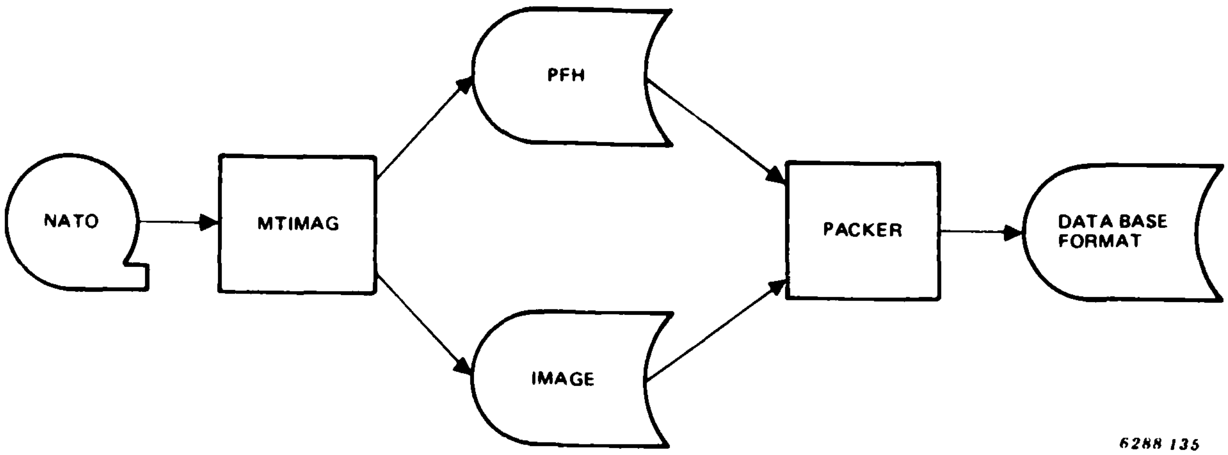

Figure 5-7. Data Base Formatting

a. Time of day
b. Sensor spectral window
c. Range (in meters)
d. Altitude
e. Picture polarity specification
f. Display range
g. Original gray levels.

The information from the NATO tape headers in converted into a more computer readable format at this step. When the file transfer takes place, the actual gray level range of the picture is compared to the stated range as an error check. If there is an error, the user is given several options to correct the situation. Then, if the transfer has been successful, the user inputs the next image number and the process is repeated.

The two scratch files created by the program MTIMAG are converted into data base format by the program PACKER. If the image is too large for the lab display, it is segmented into pieces, any one of which can be displayed. A final error check is made before the conversion takes place in order to determine the correct gray level range. After the image is packed into data base format, the user is asked if the scratch files should be deleted and if another NATO tape file conversion is desired.

5.4 DATA BASE CONTENTS

The following two tables list the laboratory tapes and the ground truthing for each tape. Table 5-1 identifies the laboratory tape number, description, source identification (ALA, GER, etc.), number of images, and whether or not basic ground truthing is available from NV&EOL. Table 5-2 shows the number of "things" currently ground-truthed for each tape, such as tanks, APC's, jeeps, etc.

Table 5-1. Data Base Source Tapes

Laboratory Tape Number	Source Identification	Description	Number of Images	Basic Ground Truth Available
100	ALA	Alabama	43	Yes
101	AP	A.P. Hill Northrop	35	No
102	VA	A.P. Hill	19	Yes
104	VA	ERIM 1	10	Yes
104	VA	ERIM 2	5	Yes
105	LA	Fort Polk 1	25	Yes
106	LA	Fort Polk 2	33	Yes
107	GER	Grafenwoehr	15	Yes
108	UNASSIGNED			
109	AZ	Yuma PNVS Tests	13	No
110	—	Pave Tack	24	No
111	CAL	Hunter Liggett 2	8	Yes
112	VA	ERIM 3	8	Yes
113	CAL	Hunter Liggett	16	Yes
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Table 5-2. Data Base Ground Truth Frequencies

Laboratory Tape Number	Tanks	APC's	Jeeps	Buses	Trucks	Burning Hulks	Cows
100	39	28	15	1	0	0	0
101			NO GROUND TRUTH AVAILABLE				
102	15	26	10	0	23	0	0
103	30	40	10	0	30	0	0
104			TAPE NOT INCLUDED YET				
105	92	16	0	0	0	46	0
106	77	11	0	0	0	60	0
107	17	0	0	0	0	0	0
108				UNASSIGNED			
109			NO GROUND TRUTH AVAILABLE				
110			NO GROUND TRUTH AVAILABLE				
111	51	0	0	0	0	0	0
112	16	32	10	0	22	0	0
113	11	0	0	0	0	0	12
	348	153	45	1	75	106	12

SECTION 6
PLANS FOR NEXT QUARTER

The present schedule for the ATC program calls for the following events to occur during the next quarter.

6.1 ATC MODEL 1 HARDWARE

Testing of the full frame rate path of the Model 1 ATC will be completed. The Model 1 ATC will then be integrated with the LOHTADS FLIR and preliminary imagery from the system will be collected.

6.2 TARGET DETECTION

The algorithm for target detection will be finalized. Large data base testing of the detection function will be performed. Also, design of the detection hardware will be 30 percent complete.

6.3 TARGET SILHOUETTING

Hardware design of the target silhouetter will be optimized through simulation and then finalized.

6.4 TARGET CLASSIFICATION

Software design for the nonparametric classification task will be finalized.

6.5 SYSTEM SIMULATION

A complete algorithm simulation of the sampled frame path of the ATC will be performed, and operational statistics reported.